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ERRATUM: In the article "Blueprint for High-Tech Industrial Development" (JPRS-CST-92-010, 22 May 92 pp 1-4), in the paragraph on page 2 beginning "In the field of aviation," the phrase "MD 75 aircraft" should read "MPC-75 aircraft".

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Measures To Develop High-Tech Industries

92FE0503G Wuchang KEJI JINBU YU DUICE in Chinese Vol 9 No 2, Mar 92 pp 17-19

[Article by Dai Xiongwu [2071 7160 2976], Hubei Province Economic Research Center: "Choices in China's Development of High Technology Industries"]

[Text] Abstract: In responding to the overall trend of world development of high technology industries, developing nations can only create corresponding models based on their own circumstances. Summarization of the experiences of various countries produces several patterns, namely the internal demand independent model, the export-oriented model, the market transfer model, and the "introduction and grafting" model. The "introduction and grafting" model is quite well suited to China. We need not only original ideas for our theoretical understanding about supporting conditions required such as technology, capital, and human talent, but we also need to intensify reform of the operating process.

Every country is trying to find ways to get ahead in response to the world trend toward the development of high technology industries. Because of the difference in industrial progress between developing countries and developed countries, developing countries have yet to become "independent kingdoms" in the development of high technology. Thus, they cannot mechanically copy western models. They can only create corresponding development patterns based on their own circumstances. Summarization of the experiences of various countries yields the following several patterns:

1. The Internal Demand Independent Development Model

The guiding principle for this model is that even though the country's production of high technology products is not such that the products are able to compete in international markets, the building of one's own high technology industrial system independently and autonomously is necessary in order to advance the attendant domestic development of traditional industries. The specific way of doing this is to develop domestic markets and satisfy demand as a starting point in an effort to develop self-sufficient production, and to watch for opportunities to expand exports to other less developed nations. This pattern depends on the existence within the country of a certain market demand. In addition, it requires the existence of a relatively low-priced manpower market. Classic examples of countries that have adopted this pattern are Brazil and India. Before reform and opening to the outside world, China used this pattern primarily. The advantage of this pattern is that even though the performance and quality of the high technology products that the country produces is less than the same kinds of products from developed countries, one can independently develop high technology products through actual production, and one can engage in batch production through the use of low-priced manpower that lowers costs. This permits the production of products that largely satisfy domestic demand, thus playing a role in import substitution. This kind of follow along style "going to middle school" makes it difficult to catch up with the speed of development of technology in developed countries. Very likely the result will be an ever widening technological gap, and an ever lower ability to absorb new technology, and ultimately the loss of the possibility of development.

2. The Export-Oriented Model

The central component of this model is that even if no market demand exists within the country itself, the development of export markets is necessary to the production of high technology products. The specific sequence of development is as follows: Use attractive conditions to attract foreign corporations to build factories in the country, then use the work force in the country to assemble products for sale in the investing country's markets. With improvement of population quality and research and development capabilities as a goal, the local government provides a large amount of investment for education, and for research and development, and it also tries to open domestic markets to advance industrial modernization. This model relies on a fine investment climate and attendant low-priced manpower.

Countries that use this model are mostly the "four small dragons" of Asia as well as Malaysia. South Korea is the most typical example.

The key to success of this model is the existence of a very effective basic investment capability, including an educational foundation and an industrial foundation. In addition is the existence of a fine climate for technology transfer, as well as a system having western management features.

3. Market Transfer Model

The main country that adopted this model is Mexico. This model consists of the use of markets existing in one's own country, using market transfer conditions to attract foreign corporations to build factories in one's country to produce high technology products. These corporations must employ local country engineers and technicians and impart to them key techniques bearing on the entire process of research and development of high technology products. The ultimate goal in adopting this model is to make local engineers and technicians able to set up high technology industries independently for the local country itself, and to provide premium products and services.

This model relies on the existence in the local country of a highly attractive high technology products market, and it also requires the existence of a very good ability to absorb and digest technology.

4. "Introduction and Grafting" Model

The crucial problem in this model is how to coordinate properly the digestion and absorption of imported technology with one's own research and development. The guiding thought behind this method is the use of the industrial foundation that already exists in one's own country (including a foundation for the development of high technology), paying close attention to the digestion and absorption of imported technology, and paying close attention to the dovetailing of imported technology with the local industrial foundation so that the introduced technology produces locally and the graft takes. This model depends on the existence of a certain self-development capability along with very good ability to absorb and spread technology.

The widespread borrowing of foreign experiences is for the purpose of further building and perfecting one's own development road. Comprehensive analysis shows the introduction and grafting model to be rather well suited to China. However, after many years of practice, we not only need original ideas for a theoretical understanding about supporting conditions such as technology, funds, and human talent, but we also need intense reform of the operating process.

1. Technical Foundation Is the Keystone for the Development of High Technology Industry

Everyone is aware that science and technology are the common wealth of mankind. No country's or region's advanced technology can rely entirely on self-sufficiency. Only through constant importation of new technologies is it possible to accelerate one's own development. This has been the road that all industrialized countries of the world have taken.

In recent years, quite a few Chinese firms have actively imported advanced foreign technology from which they have gained greatly, but there have also been numerous problems. Getting tremendous benefit from imports requires the following strategic changes:

A change from receiving blood transfusions to making one's own blood. Many years of experience and lessons everywhere show that one cannot get genuine scientific and technical progress simply by buying technology abroad to develop one's own country's economy. Much less is it possible for one's own high technology products to make a firm lodgement in international markets. We must use various kinds of effective measures to channel our scientific and technical strength toward the transformation of traditional industries, and in the direction of digesting, absorbing, and innovating. We must link technology imports to equipment research and development and scientific research on key problems, as well as to the development of another generation of products, thereby increasing the "blood making" function of high technology imports for the rapid sinicization of imported technology and innovation. In this way it will be possible to shape a competitive "blood-making" technology import mechanism that imports, digests, innovates, and ships out.

A change from the importation of technology for use to the importation of technology for reverse engineering purposes. Reverse engineering technology imports requires the further scientific analysis and research of imports that one knows to be thus and so in order to find out why they are thus and so. In order to understand reverse engineering technology, one has to make both a full analysis and study of it, and reverse engineer similar technologies insofar as possible. One has to persevere in systems analysis study, reverse engineering all the technical secrets of all systems in the imported product including composition, materials, technical equipment, packaging and use. Not only must one look at the outside, but one must also apply all possible scientific testing and analysis methods to understand internal composition, performing destructive research to do thorough reverse engineering. It is particularly necessary to make a major effort to test, analyze, and calculate technology in order to master the essence of the new techniques, new products, and new technology, and to draw inferences about other things from a single thing, achieving mastery through a comprehensive study of the subject. This is an added value cycle that goes from imports to reverse engineering, to digestion, to innovation, to further imports.

A change from exports that are going out of date to cutting edge exports. When importing, we must actively promote a strategic change from imports that are going out of date to cutting edge exports. All enterprises, particularly enterprises the quality of whose technology is relatively high, must increase their sense of the need to obtain high technology in great demand. In the development and production of foreign trade products, they must diligently study and constantly import the world's newest and most advanced techniques and technologies, and increase investment in science and technology more rapidly so that Chinese products incorporate more high technology, thereby increasing consumer appeal to enable Chinese products to acquire a high reputation abroad and sell well in international markets.

A change from haphazard importing to fluid importing. By so-called fluid importing of technology is meant re-importing when conditions are right, timely importing, importing to meet needs, and importing to keep up to date, thereby getting out of the vicious circle of haphazard importing, bringing the importation of technology into a new realm of close examination and scientific decision making. This will permit the escalation of imports from the low to the high, from the usual to the unusual, from the simple to the complex, and from a single technology to multiple technologies. This can then be used to increase enterprises' technological dominance in international market competition, gaining the return from imports of "overwhelming adversaries to win victory."

A change from the importation of hardware to the importation of a mixture of hardware and management know-how. In order to spur enterprises to change as rapidly as possible from the importation of hardware to the importation of a combination of both hardware and management know-how, the authorities concerned will have to understand the principle of combining hardware with management know-how, making sure that they employ it in their examination and approval of technology imports. All enterprises must pay attention to the improvement of their own abilities to move ahead in management know-how, increase their investment in management know-how, and use all available channels and diverse means to create conditions for the importation and digestion of hardware. In this way, they will be able to make the technology import support system keep pace with or be ahead of hardware imports.

2. Capital Is a Prerequisite for the Development of High Technology

High technology industries cannot be developed without a certain amount of capital and reliable channels for raising capital. Capital is limited in China at the present time. In addition to self-reliance, we must do all possible to import foreign capital. Taking in foreign investment is an important part of China's opening to the outside world. China has already shaped a multi-level pattern of opening to the outside world for attracting capital that runs from the special economic zones to coastal cities opened to the outside world, to coastal economic development zones to inland areas. This provides a broad and rather ideal arena in which foreign traders can invest.

China's development prospects for the attraction of foreign trader investment are broad. Whether the attraction of foreign capital can be speeded up will depend largely on our ability to make the most of our advantages, and whether we can eliminate shortcomings in our work with all possible speed, make the most of strengths while avoiding weaknesses, put our shoulder to the wheel, and do a solid job in creating an investment environment that is very attractive to foreign capital. At the present time, attention must be given to the following problems:

Major efforts in improving publicity abroad. We must publicize through various channels, in a planned way, and according to customary practices used in investing countries China's plans, policies, and circumstances regarding the opening to the outside world and the absorption of foreign capital, and use facts to demonstrate to international society that China's policy of opening to the outside world and absorption of foreign capital is an unswerving policy in order to eliminate the worries of foreign traders insofar as possible.

Efforts to run well existing enterprises in which foreign traders have invested. We must make up our minds to help solve problems in each one, and to run each of them well. This can have a very good influence in increasing foreign trader investment confidence, attracting more foreign traders to invest in China, and establishing a fine image of China abroad.

Strict control over the kinds of projects in which foreign capital is invested. Heretofore foreign capital has been little invested in energy, transportation, raw and processed materials, and high technology projects—all areas for priority development in the national economy. Much foreign capital has been invested in ordinary processing projects and repetitive construction projects. Henceforth, new projects must be examined and approved strictly in accordance with national industrial policies, and regulations for guiding the direction of foreign trader investment, all projects being conscientiously sifted and optimized to improve project quality and standards so that foreign investment goes into desirable projects.

Continued close attention to improvement of the investment environment. While giving close attention to improving the tangible climate for investment, efforts must be made to improve the intangible investment climate. Laws and regulations applying to foreign trader investment must be further improved; the consistency, continuity, and solemnity of policies must be maintained; Sino-foreign bilateral agreements must be strictly enforced; the legal rights and interests of both parties diligently ensured for reciprocal benefit; and foreign investment administrative organs must be made to function better for further improvement of operating efficiency and to provide good service for foreign trader-invested enterprises.

3. Human Talent Is the Foundation for the Development of High Technology

Technological progress depends on the creation of human talent skilled in science and technology; therefore, competition in science in technology is actually competition in human talent.

For a long time, a human talent war has been relentlessly waged internationally. China is a large developing country having a large population and scant resources. Maintenance of steady, sustained economic development in China requires maintenance and full use of people of great talent in this war. In addition to the energetic nurture of human talent, we must also take certain actions for the energetic importation of human talent.

Practice during the past several years shows the need to pay close attention to the following tasks:

Give more prominent place to the importation of foreign intellect than to the importation of equipment and capital, fully understanding its importance.

Draw up realistic plans to integrate closely imported intellect with economic construction.

Link the importation of foreign intellect with the promotion of enterprise reform and technological progress.

Actively and enthusiastically provide services to create a fine work environment for foreign experts.

Adopt a spirit of a craving for knowledge, open-mindedly learning from foreign experts, acquiring their strengths to remedy our weaknesses.

Further widening of channels for the importation of foreign intellect, importing urgently needed human talent first.

While closely checking on personnel going abroad to study, their dispatch should be accelerated. In addition a social ethic of respect for human talent, and respect for science should be created so that capable people of all kinds are able to discharge their duties wholeheartedly, contributing their intelligence and ability entirely to China's four modernizations. China was formerly one of the birthplaces of human civilization. In the competition to develop high technology industries today, it must once again be a mover and a shaker, standing tall among the world's powerful.

China Set To Update Industrial Technology

40101018A Beijing CHINA DAILY in English 8 Apr 92 p 1

[Article by Zhou Jie: "China Set To Update Industrial Technology"]

[Text] China will concentrate on updating deficient industrial technology and equipment, according to a just-released government report on technological advancement in China for the next 30 years.

The report sets a target date of 2020 to modernize China's industrial equipment and improve technical know-how. The report also stresses transforming high-tech research into products.

This is the fifth time the government has issued a long- or medium-range technological development plan.

The previous four were in 1956, 1962, 1978, and 1983 and played important roles in establishing China's scientific and industrial base. The draft work for the current plan started in 1988 and was approved last month by the State Council.

Technology in China's major industries should reach the level achieved by advanced countries in the late 1970s and early 1980s by the year 2000, the report says. And by 2020, the country aims to catch up with Western industrial standards of the early 21st Century.

The report calls for reducing energy and material consumption, improving product quality, and enhancing products' competitive position in the international market.

Computers and other advances should be widely available in Chinese enterprises to improve production and efficiency, the report states.

The report singles out energy, transportation, materials, electronics and machinery as needing improvement.

The report says China should concentrate its research efforts on micro-electronics, computer science, robot technology, bio-technology, new materials and space technology.

According to the report, China will work on sending astronauts into space in the next few decades.

In military science, the report highlights the key role technology research should play in improving the performance of major conventional weapons and overall military power. The country will keep on developing high-tech conventional weapons and maintain its defensive nuclear capabilities, the report says.

In agriculture, the report proposes protecting and using more effectively farmland currently in use. Bio-engineering technology should be used to develop new kinds of plants and animals, the report says.

Significance of State Medium and Long-Term Development Program for Science and Technology

92FE0503A Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 2, Mar 92 pp 10-13, 20

[Article by Hu Ping [5170 1627]: "Grand Program for Advance Toward Science and Technology in the New Century—Discussion of the Strategic Significance and Characteristics of China's Medium and Long-Term Program for the Development of Science and Technology"]

[Text]**1. The formulation of a state medium and long-term development program for science and technology marks the entry into a new stage of development of Chinese science and technology.**

Not long ago, the 94th State Council Standing Committee approved in principle the "State Medium and Long-Term Development Program for Science and Technology." This marks a new milestone in the development of science and technology in China. In the decade of the 1990's, human society is approaching the turn of the century. The period between now and the first 20 years of the coming century will be a period of tremendous change in the history of human social development. The development of science and technology by leaps and bounds, and its widespread application will become the element having the most profound influence during this period. Formulation of a medium and long-term program for the development of science and technology is of crucial importance for realization of the strategic policy that the CPC Central Committee has proposed of "science and technology being the primary production force" that "enables economic construction to change to a path of reliance on scientific and technical progress, and a rise in the quality of the work force." In addition, it will play a crucial role in advancing and

ensuring realization of China's second and third step strategic goals in development of the national economy.

The task of drawing up a medium and long-term development program for science and technology was proposed in 1987 by the 13th National Party Congress. Earlier, the 12th National Party Congress had decided to make science and technology the strategic emphasis of national economic development. The 13th National Party Congress further elevated science and technology to the foremost position in the national economic development strategy. It noted that "modern science and technology, and modern management are decisive factors for improving economic returns; they are the mainstays for the advance of China's economy toward a new growth stage." "Science and technology, together with education are to be given first place so that the building of the economy can change to a path of reliance on scientific and technical progress and a rise in the quality of the work force." The Congress suggested that the State Council "draw up a medium and long-term scientific and technical development program, and intelligently organize scientific and technical forces throughout the country for concerted efforts to put it into effect with all possible speed."

Acting on the State Council's instructions, national agencies in charge of science and technology organized the various central government ministries and commissions, and leaders and experts in the scientific and technical field throughout the country to prepare for the joint drafting of the program. In 1988, the State Council ratified establishment of a "team of experts to draft a state medium and long-term scientific and technical development program. Between 1988 and the summer of 1990, after two wide-ranging solicitations of views and intense discussion by scientific and technical experts in various trades and industries, and ten changes in the draft, the team of experts finally completed the writing of the "program." In addition, it drew up a "medium and long-term scientific and technical development program covering 33 fields and three special topics as an addendum to the "program." The "program," which consists of six parts," discusses the current state of development of science and technology in the world and China's choices, explains China's strategy, goals, plans and key area of scientific and technical development, proposes the further intensification of reform and expansion of the opening to the outside world, and formulates a series of major policy measures for the development of science and technology in the new period.

One can see from the foregoing process that the task of drawing up a state medium and long-term program for the development of science and technology was completed, in fact as well as in name, by the joint efforts of people involved in science and technology throughout the country, and scientific and technical experts in all trades and industries. It concentrated the collective experiences and knowledge of leaders, experts, and the public, and it was both a scientific summarization of the rich experiences gained in scientific and technical work in the 42 years since the founding of the people's republic, and also a mobilization order for a century-spanning advance toward science and technology. The main contribution of this "program" is its close linking of science and technology with the building of the economy. It sets the strategy and plans, the goals and the key points for the development of science and technology for the next several decades, and clarifies a series of major problems involving the relationship between the system and policies in the development of science and technology such as the relationship between the present and the long-range, the relationship between matters to be emphasized and routine matters, the relationship between research and development, between plan and market, between competition and cooperation, between imports and innovation, between following along and catching up and surpassing, between the raising of standards and popularization, etc. All these matters were planned as a whole and given due consideration to provide China's scientific and technical workers for the next several decades with guidelines they can follow and methods on which they can rely for sustained, steady, and coordinated development. It is in this sense that the medium and long-term scientific and technical development is a "grand charter" for the development of scientific and technical endeavors during China's preliminary stage of socialism. The "program's" formulation and implementation marks China's entry into a new stage of development of science and technology.

2. Significance and Role of the Formulation of the State Medium and Long-Term Program for the Development of Science and Technology

China scored major results from the successful formulation of scientific and technical development plans several times in the past. Each of the country's 5-year plans also contained a scientific and technical development component. Therefore, what is the special need to draw up a medium and long-term scientific and technical development program? Just what is the significance and role of the formulation of a medium and long-term scientific and technical development program?

Actually, the drawing up of a medium and long-term scientific and technical development program was not arbitrarily decided on out of subjective desire or as a discretionary matter. Instead, it was decided on because of the urgent need for domestic and foreign economic and social development, particularly because of the state of development of science and technology. It is common knowledge that science and technology have become the decisive elements powering modern human social development, and that they are the key to China's four modernizations. The sustained, steady, and coordinated development of science and technology have a bearing on the vigorous development of the country's economy, the stability of society, and the consolidation of national defense. They have a bearing on both the success or failure of the country's modernization, and on the country's long governance and lasting peace.

First of all, in terms of the international macroclimate, the formulation of a state medium and long-term scientific and technical development program is urgently needed to meet the challenges of the new world technological revolution. During the last half of the 20th Century world science and technology advanced by leaps and bounds. A new world technological revolution was gestating even during the period of World War II, and by the 1970's and 1980's a qualitative change had taken place. A new technological revolution characterized by across-the-board breakthroughs in a series of new sciences and technologies including microelectronics technology, biological engineering, new materials, new sources of energy, and space navigation technology unfolded with incomparable force on a world scale, marking the arrival of a dizzying period of development of social productivity. Both developed and developing countries all felt its serious impact. In order to meet the challenge and avoid falling behind, they hurriedly proposed new development strategies centering around the development of science and technology. "Strategic defense planning", which was a basic national policy of the United States; the "Eureka" Plan of European countries such as France; Japan's "New Human Domain Research Plan" and the former Soviet Union's "Year 2000 Scientific and Technical Progress Program" etc were all proposed against this backdrop. Other countries and territories such as Austria, Spain, Mexico, and South Korea came up with their own plans. Their goal in so doing was to try to occupy the heights of scientific and technical, and economic development to wage a gun powder-less scientific and technical war. Whoever led in science and technology would be in a powerful political, economic, and military position. Conversely, whoever lagged in science and technology would be under the economic control of others, would be in a passive and vulnerable position militarily, and would become politically a vassal of international powers.

Faced with such a situation, China could not remain aloof and indifferent, doing nothing. Since the founding of the people's republic, China has scored brilliant achievements in science and technology that have attracted the attention of the world. However, overall, the level of China's science and technology remains not very high; a substantial gap still exists with developed countries. The world is currently in a period of relative peace. If we do not use this favorable opportunity, and spare no effort to accelerate the development of the country's science and technology, we will commit a major historical error. It is for this reason that the Party and government expends extremely great energy on attention to scientific and technical work. During the past more than a decade, Comrade Deng Xiaoping has repeatedly stressed the strategic significance and the urgency of the development of science and technology, putting forward the important thesis of science and technology being the primary productive force. Comrade Xiaoping said: "The coming century will be a high science and technology century. China must develop its own high science and technology at all times to occupy a position in the world's high science and technology realm." It was against this background that the state medium and long-term science and technology development program was proposed. The "program" takes its cue from the overall trend of development of world science and technology in combination with urgent needs in building China's economy and national defense. It provides a systematic exposition and in-depth planning of major branches of learning and fields, including basic research, applied research, and developmental research—particularly high science and technology research—for the next 30 years in China. This holds decisive importance for greatly shortening, or even catching up in certain major fields with the advanced levels of developed countries during the early part of the 21st Century, or a slightly longer period of time.

Second, in terms of the needs of domestic economic and social development, formulation of a state medium and long-term science and technology development program holds even greater strategic significance. It has a bearing on the major issue of whether China will be able to move ahead smoothly with the second and third step strategic goals in development of its national economy.

During the 1990's, China's modernization will shift from the first step strategic goal to the second step strategic goal—achievement by the end of the present century of a per capita GNP of approximately $800, and attainment of a comfortably well-off standard of living. This shift is actually a shift in which the work emphasis of the entire national economy will shift from non- intensive operation to reliance on scientific and technical progress following, the shift in the work emphasis of the entire Party centering around the building of the economy. This second shift is both a deepening of the first shift, and also a profound revolution in the country's economic foundation and superstructure. Ours is a large country having a huge population and insufficient per capita resources in which the economic foundation is weak. Because of the low level of technology and management, the social labor productivity rate is generally only 5 percent that of developed countries. For a long time, China's economic development has been sustained by low-priced energy and raw and processed materials, and low-priced agricultural by- products and low wages. During the past decade, we have realized the strategic goal of doubling the gross output value of industry and agriculture; however, this has been realized largely through the investment of a large amount of money and intensive consumption of resources, as well as primarily through the extensive expansion of reproduction. It was characterized by high inputs and low outputs; high consumption and low quality; high costs and low returns. Our realization of a second doubling during the coming decade will be much more difficult that during the first decade. This is because the base figure for GNP 10 years ago was relatively low, and population pressures were less than at the present time. Domestic and foreign financial conditions were also better than they are today. During the coming decade, these favorable factors will

weaken relatively, making it difficult to take the old road of reliance primarily on the extensive expansion of reproduction. Another doubling of GNP will require taking a new road of intensive expansion of reproduction that can be attained only through scientific and technical progress.

The medium and long-term science and technology development program is closely related to the strategic goals of national economic development. It provides a strategy and goals for the development of science and technology. The "program" states that the basic strategy for China's scientific and technical development for the coming 10 to 30 years will be: heightening the scientific and technical awareness of all the people; mobilizing and attracting the majority of scientific and technical forces to commit themselves to the main battlefield of building the national economy; and efforts to absorb and apply as quickly as possible world advanced applied technologies to accelerate the technological transformation of all fields of the national economy. The development of science and technology must take as its primary orientation the modernization of industrial technology and equipment for large scale production. It must focus on the development of high technology and high technology industries, and steadily emphasize basic research. The "program" stipulates the basic policy for China's development of science and technology to be as follows: Building of the economy must rely on science and technology; and scientific and technical work must orient toward building of the economy to advance science and technology and the coordinated development of the economy and society. On the basis of the foregoing strategy and policy, the "program" states the economic and social goals in the development of China's science and technology for the next 10 to 30 years to be as follows: concentration on solving problems in the production of industrial and agricultural commodities, effectively easing population, resources, and environmental pressures, increasing overall national strength, and raising the people's standard of living. The "program" proceeds from the reality of a relatively low level of overall development of the nation's industrial technology, and calls for an effort to make the country attain the technological level of developed countries during the 1970's or 1980's in most industrial fields by the year 2000, and to reach the technological level of developed countries during the first decade of the 21st Century by the year 2020. In this way, it will be possible within 30 years to narrow the gap in industrial technology between China and developed capitalist countries to approximately 10 years.

Third, formulation of the medium and long-term science and technology development program is also an urgent necessity for improving the country's security. During the 1990's, sudden changes occurred in the international situation; various contradictions in the world intensified; and both global and regional disputes emerged in a steady stream. The situation is extremely precarious. In order to ensure China's peaceful construction, we must exercise vigilance in peacetime. Realizing that preparedness is the best way to avert calamity, we must further increase the country's defense capabilities. Experiences in the Gulf War demonstrate that modern warfare founded on high technology has wrought qualitative changes both in military strategy and tactics, and in combat methods and techniques. Those who lack advanced science and technology will be in a passive and vulnerable position and will suffer defeat. The medium and long-term science and technology development program, based as it is on the state of development of international military science and technology and the needs of China's military strategy during the new era, calls for important actions to improve scientific research for national defense and modernization of war industries. It requires that while maintaining the effectiveness of a military deterrent force, the emphasis should be on development of sophisticated weapons system that are able to increase combat capabilities tremendously, developing all sorts of sophisticated science and technology including precision guidance technology and military electronics information technology. Implementation of this "Program" will raise China's national defense science and technology to a new level. This will have far-reaching effects on the modernization of China's national defense.

Fourth, formulation of the medium and long-term science and technology development program is necessary for the further intensification of reform and expansion of the opening to the outside world. During the past decade, major advances have been made in reform of the country's science and technology system. However, due to the relatively short period of time and the lack of experience, numerous reform measures have halted in the trial stage. Overall and long-range planning has been lacking, and no complete system has taken shape. The drawing up of the medium and long-term program can make use of a relatively long time span to improve coordination, to straighten out various relationships, and to do complete planning and deployments that increase the transparency of reform and avoid blindness in action. The overall goals of future science and technology system reform called for in the medium and long-term science and technology development program are as follows: the building of a new system that is in keeping with a socialist commodity economy, and that promotes a close link between science and technology and the economy. The key point in reform is the building of a new operating mechanism that combines perfection of plan management with the strengthening of market regulation to make fullest use of the coordinated advantages of the two. As a corollary to this, the program calls for a whole body of tasks including restructuring of the whole country's science and technology organization, a change in government functions, the building of a macromanagement and regulation and control system, the building of a socialized management system for scientific and technical personnel, the building of a socialized service system for science and technology, the building of a multi-component system for investment in science and

technology, and perfection of the business enterprise and rural scientific and technical research, development, promotion, and service system. The "program" requires that all reform measures be carried out in coordination the basic pattern of this new system being fashioned before 2000.

On the subject of the opening to the outside world, in view of the overall trend toward greater internationalization and integration of science and technology during the coming century, the "program" proposes a series of measures for further policy relaxation, and widening of the opening to the outside world. The program calls for China's scientific and technical personnel to take active part in large international cooperative research plans and projects, to increase the percentage of cooperative research, joint development and cooperative undertakings in international scientific and technical cooperation, and to be active in the organization and development abroad of various kinds of research and development organizations, information and service agencies, and planning and production agencies. In the realm of cooperation and exchange, China should actively attract foreign scientific and technical talent, and import advanced technology to improve the country's ability to be self-reliant in order to shape a uniquely dominant position in science and technology and the ability to compete economically for China.

Finally, the formulation of the medium and long-term science and technology development program will play a major role in providing impetus to the building of socialist spiritual civilization. Science and technology are the crystallization of several thousand years of development of civilization and knowledge; they are an important keystone for the building of socialist spiritual civilization. Modern science and technology have a profound effect on people's spiritual life. They provide new inspiration for mankind's social value concepts and moral concepts. During the early stage of socialism, China's economic, social, and cultural development remains very unbalanced. In many regions, particularly in the country's far-flung rural villages, ignorant, backward, and superstitious customs, ideas, and ways of life are extremely widespread. The medium and long-term science and technology development program employs modern science and technology to guide social development, to help people widen their avenues of thought to invigorate spirit, to transform customs, to establish civilized, forward-looking, healthy, and scientific ways of life, to use materialism to criticize idealism, and to use atheism to criticize theism and all kinds of feudal superstition, thereby raising to new heights the building of spiritual civilization by all nationalities.

3. The Character and Distinguishing Features of the Medium and Long-Term Science and Technology Development Program

This medium and long-term science and technology development program differs very greatly from the many scientific and technical plans of the past. It is distinctive in character, content, and form.

First, this is a medium and long-term science and technology development program that spans a period of 30 years while previous scientific and technical plans were generally limited to about 10 years. This means that the point of departure in drawing up the program focused not only on current and near-term needs, but more on needs that go beyond the century. Forecasting the development of and changes in science and technology for 30 years is very difficult. Nevertheless, forecasting the general trend of development of world science and technology during this period is possible. Basically, the formulation of a grand strategy for a country generally requires an examination of problems over a relatively long period of time— several decades, for example— for it to make fairly good sense. Only in this way can problems is looked at and dealt with in an overall and complete way. Some things that must be done but that are difficult to do at the moment, and some actions from which it is difficult to see results in a short period of time and that can only show results over a long period of time can be addressed and solved only during a period of medium and long-term development. It was from such a need that the formulation of the medium and long-term science and technology development program proceeded.

Second, this program is not purely a program for the development of science and technology, but rather a program that relies on scientific and technical program to advance economic and social development. Although the "program" makes plans and assignments for the building of all fields of learning, it mainly concentrates on solving scientific and technical problems in industrial and agricultural production. The program shows particular concern for the development of science and technology in the special fields of China's agriculture, energy, transportation and communications, materials, machinery and electronics, consumer goods, and social development for the next 10 to 30 years. It proposes specific goals and actions to be taken, and embodies in a clear-cut way the special character of science and technology as the first productive force that directly serves the building of the economy, as well as reliance on science and technology to readjust the industrial structure.

Third, this program is mostly a policy document of a theoretical character in which guiding principles with realities are combined, guiding principles being dominant. It concentrates on setting forth strategy, goals, plans, and policy issues, and it particularly emphasizes new concepts, new ideas, and policy innovations and breakthroughs in the development of science and technology. For example, in the discussion of science and technology being the primary productive force, on conceptions about scientific and technical system creativity and system creativity under a planned commodity economy during the preliminary stage of socialism, in discussing development strategies and polices for the

development of science and technology under new circumstances in China, in discussing a change in government functions and enhancing the functions of social organizations, as well as in discussions about the trend of development and character of modern world science and technology, etc, it conveys a theoretical flavor and innovative sense.

Stimulus to Innovation in Industrial Enterprises Surveyed

92FE0503B Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 2, Mar 92 pp 17-20

[Article by Ma Chi [7456 7459], Yang Dongde [2799 2639 1795], and Jia Weiwen [6328 5588 2429]: "Analysis of the Status of Technological Innovation in China's Industrial Enterprises"]

[Text] In cooperation with the Yichang Technology Innovation Research Team in Hubei Province, we conducted a questionnaire survey among 105 manufacturing enterprises having an output value of more than 1 million yuan for the completion of a validation analysis [shizheng fenxi 1395 6086 0433 2649] of enterprise technology innovation. This survey revealed the ingredients of the innovation process, the sources of innovative activity, the factors stimulating and obstructing innovation, how innovation comes about, and its effects. Such wide-ranging and penetrating validation studies to reveal and analyze the innovative behavior of enterprises are still a rarity in China. The following provides an explanation and analysis of the survey.

1. Brief Explanation of the Survey

This survey sample consisted of a total of 105 enterprises from which the questionnaire return rate was 100 percent. We classified the returns in four different categories on the basis of enterprise size, industrial sector (or trade), administrative subordination, and system of ownership (enterprise economic type).

Enterprises were classed as large, medium, or small in accordance with applicable national regulations. Large enterprises numbered five and medium enterprises numbered 40 or approximately one-third of the total sample. Small enterprises numbered 60 or approximately two-thirds of the total sample. The industrial sectors to which the enterprises belong included machinery, electronics, metallurgy, the chemical industry, pharmaceuticals, light industry, textiles, construction materials, and foodstuffs, with most concentrated in the light industry, machinery, and textile industry sectors. In terms of administrative subordination, enterprises fell into one of four categories, namely central government, municipality, county (or district), and township and town. The system of ownership was of three kinds: ownership by the whole people, collective ownership, and partnership between ownership by the whole people and collective ownership. We found more than 300 variables including literal variables, numerical variables (including interval variables), logic variables, and sequencing variables for which we constructed a data base to analyze the technology innovation activities of industrial enterprises.

2. Basic Concepts and Definitions

Innovative activity differs from the day-to-day activities that an enterprise must perform to maintain normal production. It means a qualitatively completely new kind of innovative activity that an enterprise performs, including product innovation and technological innovation.

Product innovation means the products developed for production. Such products differ in their technical performance and material make-up from the products that the enterprise formerly produced, or they may be products produced from the major improvement of old products. Product innovation may grow out of various gradual innovations made on different parts of the product. The source of product innovation may come from technology derived from research and development, or from technology obtained by other means.

Technological innovation means the use of new production methods. Technological innovation may be used to produce new products or to make major improvements in old products; it may also be used to improve markedly the production efficiency of existing products. The importation of new kinds of machines or equipment (but not to replace or expand existing technology) may also be regarded as technological innovation. Technological innovation and product innovation stem from the same source.

3. Analysis of the Innovation Survey

The new innovation survey that we conducted covered the following: enterprise development strategy; technical opportunities open to the enterprise, i.e., innovative ideas from a wide variety of sources; enterprise technical capabilities, including the enterprise's ability to conduct research and development, as well as things such as the building of cooperation and coordination networks among enterprises, and contacts with government departments; factors helping and impeding innovation; cost innovation, and innovation in results. Each of the main survey results are discussed in turn below.

1. Enterprise Development Strategy

We broke down enterprise development strategy into three parts namely, product and market development strategy, technology development strategy, and development strategy for the use of production inputs. The survey showed that most enterprises made product and market development strategy their first choice; however, large enterprises, electronics and building materials firms, and enterprises under central government jurisdiction showed a high regard for the choice of technology development strategy. The enterprises that chose a

development strategy for the use of production inputs as their primary strategy were construction materials, pharmaceuticals, electronics, and machinery firms. The ranking in order of importance of development strategies among all the enterprises surveyed was as follows: product and market development strategy, development strategy using production inputs, and technical development strategy.

Product and market production strategy: Virtually all enterprises chose products and markets as their primary strategy. Only machinery firms made existing products and existing markets, and new products and existing markets their two primary strategy choices, showing that such firms regarded highly the opening of existing markets. Foodstuff firms made existing products and existing markets their first strategy, and they placed a new products and new market strategy last, thereby reflecting the stability of food products and markets. This is also the reason for the slight innovation in foodstuff industry products. For enterprises surveyed as a whole, ranking of product and market development strategy in order of importance was as follows: new products and new markets; new products and existing markets; existing products and new markets; and existing products and existing markets. For most enterprises, the major concern was how to use new products to capture markets.

Technical development strategy: Most enterprises chose the development of new technology and improvement of existing technology as their first two development strategies. They regarded other strategies as unimportant. However, in addition to the development of new technologies, large enterprises ranked the importation and use of foreign technology, and improvement of existing technology as their second development strategy. At the same time, they also attached importance to the importation and further development of foreign technology (making it their third choice of a strategy). This shows the high degree of importance that large enterprises attach to the importation of foreign technology. It is noteworthy that the first choice of strategy by electronics firms was further development of the technology of others inside the country. The ranking in terms of importance of technology development strategies by the enterprises surveyed as a whole was as follows: development of new technology by the enterprise itself, improvement of the enterprise's existing technology, use of technology that others in the country have developed, further development of the technology that others in the country have developed, importation and use of foreign technology, importation and further development of foreign technology.

Use of a production input development strategy: Virtually all types of enterprises made more effective use of existing inputs their first strategy choice, and the reduction of manpower their last strategy choice. Most made the conservation of energy their second strategy choice. However, large enterprises, electronics, machinery, and chemical industry firms made the use of new inputs their second strategy choice. County (and district) enterprises made the conservation of energy their first choice of a strategy. The ranking in order of importance of the use of a production input development strategy for the enterprises surveyed as a whole was as follows: More effective use of existing inputs, conservation of energy, use of new inputs, reduction of manpower.

2. Sources of Innovative Ideas

Enterprises' technical innovation opportunities stem from a wide range of sources. These may be divided into the two categories of in-house and outside sources. Outside sources include government impetus, market stimulation, and other external stimulation.

The statistical results show that most enterprises regard internal impetus as the most important source of innovation, market stimulation placing second. However, large enterprises regard government impetus as the most important source, and enterprises administratively subordinate to the central government regard government impetus as the most important source after in-house impetus. Construction materials and metallurgy firms also regard government impetus as the most important source of innovation. Conversely, county (or district), and township and town enterprises, as well as enterprises in the collective economy regard government impetus the least important source of innovation. This shows that government impetus to innovation plays a different role in different types of enterprises. The ranking of sources of technological innovation among the enterprises surveyed as a whole was as follows: in-house impetus, market stimulation, government impetus, and outside stimulus.

Of all the factors making up in-house impetus, plant management holds first place among the enterprises surveyed, with in-house research and development and sales holding nearly equal importance for second place. The bonus system for production and innovation was not an important factor.

Of all the factors making up government impetus, only policies, laws and regulations, standards, and norms were important for the enterprises surveyed. Command style plans and guidance plans were an important source of innovation for large enterprises, particularly command style plans. Among the different industries, only in metallurgy industries were command style plans the most important source of innovation. This shows that the role of government planning units has a different effect on different types of enterprises.

Among the enterprises surveyed, market stimulation provided by consumer demand and product fairs were the first and second most important sources of innovation, but competition did not constitute a major source of innovation. However, market competition and product fairs did constitute a major source of innovation for township and town enterprises. Among the different

industries, the role of competition in stimulating innovative activity was manifested to a marked degree only in chemical industries.

Among the other stimulating factors for the enterprises surveyed, only the acquisition of tangible technology and intangible technology were important sources of innovation. Cooperation with others in research and development was not an important source of innovation. For township and town enterprises, however, cooperation with related sectors inside China, and cooperation with large enterprises did form an important source of their innovative activity. For the electronics, construction materials, foodstuffs, and pharmaceuticals industries, such cooperation also formed an important source of innovation.

3. Favorable Factors and Obstacles to Innovation

(1) Factors Favoring Innovation

In evaluating the factors favoring success in enterprise innovation, enterprises of all types felt that in-house factors were important influencing factors. Of all the in-house factors, research and development associated with sales and production, as well as the role of plant management were regarded as the two most important factors. The enterprise's information services were deemed the second important factor. Among the external factors for the enterprises surveyed, only the use of consulting services and technical services were considered important. Various kinds of cooperation outside the enterprise was not an important factor. Among county (or district), and township and town enterprises, however—particularly among the latter—the enterprise's various kinds of cooperation outside the plant were considered important factors. In certain industries (such as construction materials, foodstuffs, pharmaceuticals, and metallurgy), the same applied.

(2) Obstacles to Innovation

In evaluating the obstacles to successful enterprise innovation, an overwhelming majority of enterprises regarded economic factors as the most important obstacle followed by the enterprise's own potential for innovation. Only county (or district) and township and town enterprises, as well as joint venture enterprises among economic types regarded institutional and policy factors as the most important obstacle. Among economic factors, all the enterprises surveyed unanimously acknowledged the shortage of funds to be the greatest obstacle to enterprise innovation. It was generally acknowledged that risks in innovation were not an important obstacle, but both large enterprises and enterprises administratively subordinate to the central government believed that the risks of innovation were an important obstacle.

Among the factors having to do with enterprise's own innovation potential, insufficient in-house research and development, the poor skills of production personnel, the lack of technical and market information, and poor ability to respond to external changes posed important obstacles. Of all these obstacles, an insufficient in-house research and development capability was the greatest obstacle to innovation for most enterprises of different kinds. It should be noted, however, that for large enterprises, the importance of the two factors of poor ability to respond to external changes, and poor cooperation and association among sectors lay in diminished in-house ability to perform research and development. For township and town enterprises, the greatest obstacle to innovation was inability to perform research and development. Lack of technical and market information also posed an important obstacle for them. However, for enterprises under administrative jurisdiction of the central government, the greatest obstacle to innovation lay in poor ability to respond to external changes.

Among the institutional and policy factors, all of the enterprises surveyed felt that the two factors of flawed state investment and policies, and price policies, both of which hurt innovation, constituted major obstacles to innovation. Among enterprises of different sizes, the reaction of medium size and large enterprises was most sensitive on this point. Among enterprises having different subordination relationships, township and town enterprises regarded the flawed national investment system and policies as posing the greatest obstacle. Enterprises under central government jurisdiction regarded price policies as being the greatest obstacle to innovation.

A survey of other obstacles to innovation found no important obstacles among those surveyed; however, township and town enterprises and county (or district) enterprises universally felt that the too great ease with which innovations could be copied or used was the most important obstacle. By industrial sector, pharmaceutical and textile industry firms felt this to be the most important obstacle.

4. Innovation Costs

This survey sought to use the cost of innovation as a yardstick for measuring enterprises' overall innovative activity. This includes the cost of research and development, costs incurred in acquiring technology, and post-research and development production preparation costs, i.e., the cost of applying innovations, and new production capacity acquisition costs and innovation sales costs associated with the importation of new innovations. Inasmuch as enterprises usually do not record these costs in the foregoing way, the survey had to rely on rather rough estimates from personnel in responsible positions in enterprises. For the enterprises surveyed, research and development costs amounted to approximately two-thirds of total innovation costs, other innovation costs amounting to approximately one-third. Among the other innovation costs, the percentage of costs for the acquisition of new production capacity (i.e., as a percentage of other innovation costs) was highest at approximately 56 percent. Second was technology acquisition costs, which were close to 20 percent. Costs of applying innovations,

and innovation sales costs were 12 percent each. Acquisition costs of new production capacity by large enterprises greatly exceeded the average value in all the foregoing enterprises, amounting to 76 percent.

5. Innovation Results

From this survey, we derived the following various results reflecting output from enterprise innovation.

(1) Product innovation rate

Product innovation rates means the ratio between the total amount of new products and total products that an enterprise markets during a period of time. During the 5 year period 1985 - 1989, the enterprises surveyed had a 61 percent product innovation rate, township and town enterprises showing an 83 percent rate. This included pharmaceutical, light industry, and the textile industry, which had a fairly high product innovation rate.

(2) Product innovation commercial success rate

Product innovation commercial success rate means the rate at which production innovation is commercially successful. For the enterprises surveyed as a whole, the product innovation commercial success rate for the period 1985 -1989 was 81 percent; for small enterprises, it was 83 percent; and for county (or district) enterprises, it was even higher.

(3) Innovative product percentage of sales

This survey used interval value to estimate innovative product percentage of sales, which was between 21 and 30 percent for all enterprises surveyed, but between 31 and 40 percent for large enterprises. For enterprises under different administrative subordination, it was highest for township and town enterprises at between 61 and 70 percent. For enterprises under central government administration, it was between 31 and 40 percent. Among different industrial sectors, the percentage of sales was fairly high in the electronics industry, machinery industry, and light industry, the electronics industry having the highest at approximately 45 percent.

From the processing and analysis of the foregoing survey data, we can arrive at the following important conclusions:

1. Innovation is a universal activity of all industrial enterprises in Yichang City. Of the enterprises surveyed, innovative products accounted for approximately 25 percent of total sales in 1989. Among enterprises of different size, the percent of innovative product sales by large enterprises was higher than that of small and medium sizes ones at approximately 35 percent. Among enterprises under different administrative subordination systems, the percentage of innovative product sales of enterprises under central government jurisdiction was 35 percent. For township and town enterprises, it was highest at 65 percent. Among different industrial sectors, the electronics industry scored highest at approximately 45 percent.

2. Results of the study show innovation to be a complex process that derives from diverse sources. Even so, in-house sources such as plant management, and in-house research and development and sales are considered to be more important sources that external sources. This is particularly true for small and medium size enterprises. Among the external sources, an overwhelming majority of enterprises say that market stimulation holds first place. In addition, consumers have become the key external source of innovative ideas.

3. In this study, there was unanimous agreement that the greatest obstacle to innovation was a lack of funds. With the exception of large enterprises, and enterprises under central government jurisdiction, it was generally acknowledged that the large risks that innovation entail were not important obstacles.

4. Among the enterprises surveyed, research and development costs accounted for two-thirds of all innovation costs. The remaining one-third were other expenses associated with innovation.

CAS Director Reemphasizes Significance of S&T Development in 1990s

92FE0503E Wuchang KEJI YU DUICE in Chinese Vol 9 No 2, Mar 92 pp 3-5

[Article by Zhou Guangzhao [0719 0342 0664], Director, Chinese Academy of Sciences: "Being Good at Study, Brave in Creation, and Taking the Way of Independent Development"]

[Text] Science is knowledge pertaining to material structure, the interaction between materials, and the generation, movement, transformation and laws of development of different forms of materials. Technology is mankind's application of scientific knowledge already gained, and the sum of experiences summarized from practice over a long period of time pertaining to product design, the use of materials, processing methods and technology, process control, and quality control. When confronted with rich and varied natural phenomena, science always seeks ceaselessly for the origins and conditions of their occurrence in order to forecast future activity and changes. Technology, however, is finding methods and techniques for application and control that can serve design and production. Science guides the development of technology, and the development of technology steadily raises new topics for scientific research in turn.

The huge demand generated by the industrial revolution has given great impetus to the development and advance of technology. In addition, it has resulted in scientific experimentation gradually becoming, along with class struggle and production struggle, one of the three great practical activities of mankind in understanding and transforming the world. Supported by the equipment and skills that modern industry provides, the purview of scientific experimentation has far surpassed the limits of

current production practice both in terms of the space-time continuum of the objects studied, and their levels of composition and movement, thereby steadily opening new realms and new directions for the development of future technology and production.

Technology is a direct production force. The technological content of the objects of production and production tools, and the technical level of producers have become the major factors determining the degree of productivity. The direct and indirect role of science and technology on production, and the close interrelationship between them enables one to appreciate the profound implications of the thesis of Comrade Xiaoping that "science and technology are the primary production force."

What changes in the world's economic and social development will the development of science and technology bring during the 1990's? I personally believe the following will occur:

1. Greater information and knowledge will universally enter all fields of production, management and social life.

Sensitive microsensors will be widely used on all environmental factors (pressure, temperature, velocity, light, sound, electricity, magnetism, reaction speed, and consistency of substances). This will greatly expand the limits of our senses, thereby increasing means for gaining correct information.

Single mode optical fibers having a large transmission volume and low wear and tear will transmit real-time and accurate information about processes to central control units at distant sites for the real-time control and optimization of production, transportation, storage, and sales. Wide frequency band multi-tasking digital network systems will link together the work of a single units with all departments and individuals, permitting wide association and exchange of information. Video-telephones, fax machines, electronic mail, television ordering, and data exchange and processing home computer systems will be gradually built. In the mid-1990's, large computers capable of performing 1 trillion calculations per second, and personal microcomputer work stations capable of several billion calculations per second will appear. They will be able to process rapidly a large volume of information, make three dimensional drawings and identify words, translate, remember, study, make judgments, reason, and make decisions in the opening of a new area of computer use that partially replaces mental labor. Computers that control everything from ordering goods and planning to sales and services, and flexible automated production systems will fundamentally change society's production methods. Take the development of new products, for example. Today, computer assisted planning into which materials, technology and sales personnel jointly play a role is already a reality. Computers make it possible to simulate the external form and functions of products produced using different materials and technology under different design conceptions, and to determine the drawbacks that may occur in the use of each under various conditions. Designs may be finalized through comparison of the parallel work of experts in various trades, and large numbers of models. Computer controlled automated, flexible production lines can produce small lots and many varieties, and get them to market quickly. This will greatly shorten the time required by traditional methods that goes from design, to a prototype, to improvements, to trial production, to large scale production.

Tiny sensors and microprocessors working together can make many products smart, i.e., automatically make choices and adapt to different external environments. The most class example is the idiot-proof camera, large numbers of which have already appeared in the market and which perform better and better, as well as washing machines and vacuum cleaners that use fuzzy logic. A new generation of household electrical appliances and industrial control devices will certainly develop in the direction of becoming smarter.

New smart materials will be widely used. Examples include paints that change color under stress, which are used on the exterior of airplane wings as a means of discovering quickly wear and tear and defects in materials. Fabrics that can automatically adjust to temperature and breathe will be made into clothing that will be well received in the marketplace in the next generation.

2. New breakthroughs in the life sciences, biotechnology becoming the most rapidly developing high technology industry in the next century

Every adult human has 100 trillion individual cells all of which develop originally from a single fertilized egg cell. This single cell contains all of the genetic information necessary to produce all of the make-up and functions of all organs in the human body. Today, we know that this information is stored in the DNA, which is arranged in 3 billion nucleotide sequences of four different kinds. They make up all of a human's inherited genes, and they express, regulate, and control this genetic information so that the cells' division and development can occur sequentially in time and space as well as differentiate to become tissue and organs having different functions. We have already mastered some techniques for cutting and recombining genes. Thus, it is possible to remove harmful genes from some organisms and insert useful genes to produce new species. Experiments have been successful with the transfer of several genes into animals (such as the insertion into fish of a growth hormone gene), and with plants (such as the transfer of a mosaic virus-resistant gene into tobacco). However, only after the structure of nucleic acid and the laws of gene expression, regulation, and control are fully understood will large scale application be possible. "Research on determining the complete sequence of the human genome" is now underway worldwide. This research will require an expenditure of $3 billion and take 15 years. China is also conducting research to analyze the complete sequencing of the paddy rice genome. These

research projects will lay a solid foundation for the application of gene engineering to the national economy.

Research on the structure and function of large protein molecules, and the development of monoclonal antibody technology will provide new avenues of thought for the development of new drugs and medical diagnostic methods.

The nervous system, the immunization system, and the endocrine system serve identification, regulation, control, and thought functions in organisms. Their study holds not only important scientific value, but also by imitating them it may be possible to develop nerve network computers, biological microelectronic chips, biocatalysts, biosensors, and biological anti-cancer missiles. All these things will be important parts of the next generation of high technology industries.

3. For the sake of long-term sustained, and stable economic and social development, mankind must control population growth and use resources rationally. He must pay serious attention to the protection of the environment and the ecology in order to avoid a future shortage of resources and a deterioration of the conditions for survival that global changes can bring.

Industrial development brings not only a flourishing of the economy and the improvement of life, but also occasions serious pollution and intense waste of unreproducable resources. Several decades hence, petroleum will become a rare commodity. Despite vast coal reserves, which can last for several hundred years, the acid rain that the burning of large amounts of poor quality coal causes will destroy whole tracts of forests and farmlands. The carbon dioxide released will increase the global greenhouse effect, leading to a global warming of the atmosphere and a rise in sea level, which will bring new natural disasters in their wake.

Researchers are working on ways to save the natural world from the global changes taking place. This work includes reduction of carbon dioxide emissions to ease the greenhouse effect; a halt to the use of fluorine to avoid destruction of the ozone layer; protection of wild animal and plant resources to safeguard the ecological system for biological diversity, and the development of resources-conserving technologies (for energy, raw and processed materials, water, and soil). It is only on this basis that there can be long-term, sustained, and steady development of the economy. This has gradually become the consensus of informed people in the world.

China lags behind the developed nations several fold in the conservation of energy, water, and raw and processed materials. This shows that we have a very great potential for the conservation of resources. Giving impetus to the development of science and technology in this regard during the 1990's holds very important significance.

New materials play an especially important role in reducing the waste of materials and energy, and in improving product performance. For example, the use in aircraft of high temperature ceramic engines and high strength alloy turbine blades can increase engine burn temperatures by one-third. Together with other measures, this can produce another 40 percent saving in fuel. During the next decade, things such as unsegregated alloy materials will find widespread application.

Statistical data show an increase in the frequency of natural disasters in China during the past 40 years. Soil erosion and desertification remain extremely serious problems. We must do more to build and protect water conservancy facilities, forests, and grasslands, simultaneously using remote sensing and space technology in the gradual building of a nationwide environment and disaster monitoring and early warning system.

4. During the 1990's, all fields of science and technology will be completely and thoroughly developed, intertwined, and fully overlapped

The fruits of basic science will be rapidly translated into the development of new science and technology and industries.

Progress in the computer and precision machinery fields has propelled the development of instruments to observe the nature of materials on an atomic scale, thereby permitting us a new understanding of large biological molecules and some atomic groups. The carbon football (C60) composed of 60 carbon atoms that has been discovered in recent years, as well as other forms of carbon, have demolished the past view that maintained that pure carbon atoms could only form graphite and diamonds, opening a completely new field thereby. The adulteration of C60 has given rise to a series of properties such as magnetism and superconductivity, thus providing broad vistas for application. Superscale integrated circuits have developed to the submicron level. In microchips, the distance between each transistor is approximately several thousand atoms. When it reaches nanometers, each transistor will be made up from a few score to several hundred atoms. When this happens, the wave motion of the electrons will become important, and atomic groups may exhibit new properties. In these terms, our understanding is still very shallow. Just as with the insights gained from the discovery of C60, unexpected phenomena may appear that provide opportunities for new technologies and new industries.

Ceramics made from superfine powder (1 to 20 nanometers in diameter) possess toughness and outstanding high temperature resistance and high corrosion resistance properties. Photoelectric devices made of this material will have a greatly improved integration level and certain specialized properties. In combination with biotechnology, bioelectronic instruments can be manufactured. Initial laboratory testing shows this to be a vast new field and direction. It can be envisioned that nanometer technology will play an important role in the 21st century.

In the process of developing science and technology, no country holds a leading position forever. A people who

are good at study and brave in innovation can seize opportunities to move along head-on. The 1990's will be a period of general use of high technology and steady innovation for all trades and industries. International competition will be extremely intense. Simply following along and imitation have no future. This is because labor costs have greatly declined as a percentage of production costs. In addition, the protection of intellectual property rights will force imitators to pay a price. We must use study and following along as a basis for taking our own road of innovation. In every step of design, production, and management, we must consider ways to lower costs, improve quality, and increase product functions. Only in this way can China's industry and its science and technology establish itself in the world. The Chinese people are a hardworking and intelligent people possessed of very high creativity. We must have confidence in our own science and technology and industrial corps, fully stir their enthusiasm, and take the road of combining study and innovation for autonomous development to build China into a socialist power in which science and technology are highly developed, and production is flourishing.

Use of Modern Information Technology in Industrialization

92FE0503F Wuchang KEJI JINBU YU DUICE in Chinese Vol 9 No 2, Mar 92 pp 10-12

[Article by Zeng Peiyan [2582 1014 3508], Deputy Minister, Ministry of Machine Building and Electronics: "Application of Modern Electronic Information Technology To Promote Technological Progress in Traditional Industries"]

[Text] Abstract: The application of electronics technology to transform traditional industries is a road that must be taken for the modernization of the national economy. It offers an effective means of improving social productivity. Currently four large problems exist in China's application of electronics technology to the transformation of traditional industries, namely the problem of the double gap that exists in traditional industries and the electronics industry, the problem of the conflict between imports and the development of native industry, the problem of the operating mechanism and drawing up of an attendant equipment policy, and the problem of "interfacing" the application of electronics technology to the transformation of traditional industries.

Uplifting the national economy with all possible speed is not only an economic problem but also a political problem today.

How can the economy be uplifted with all possible speed? One key problem is combining industrialization with the application of information, making the fullest use of electronics information technology to transform traditional industries, thereby enabling the national economy to shift from high consumption and non-intensivity to intensivity and returns.

1. Application of Electronics Technology To Transform Traditional Industries Is Necessary for Modernization of the National Economy

China's national economy has sustained a fairly high growth rate and has scored great accomplishments during the past 42 years. In 1990, the country's GNP and national income were respectively 14 and 18 times greater than in 1950 for an annual respective rate of increase of 6.7 and 6.45 percent. An industrial system complete in every category has taken preliminary shape, and the country stands in the front ranks of the world in outputs of some major industrial wares.

Nevertheless, the primary road that China has taken for development has been to expand the scale of traditional industries. The economy has remained throughout in a stage of high consumption, low returns, and lack of intensivity. Shortages of resources and enormous waste have become main factors limiting development of the national economy.

China is relatively poor in terms of per capita resources, ranking 80th in the world in per capita output of mineral resources, which is less than one-third the world average. Per capita output is also less than the world average for things like coal, processed steel, cement, petroleum, and electric power even though China holds a leading position in the world in their output. The State Statistical Bureau estimates that because of the shortage of electric power today, between approximately 20 and 30 percent of China's industrial production capacity cannot be used. As a result, an output value of more than 500 billion yuan is lost each year. China's energy consumption per unit of GNP is between 3 and 5 times that of developed nations; its energy utilization rate is only 30 percent. Statistics show China's national income increased 9.6 fold between 1953 and 1958, but energy consumption increased 14 fold. At the present time, China's consumption of energy, raw, and processed materials roughly equals that of Japan, but China's GNP is only one-sixth of Japan's. China's labor productivity rate is only 5 percent that of the advanced world level. Such intense contrasts show that China can no longer rely on excessive consumption of energy and of raw and processed materials to ensure national economic growth.

The historical process of economic development in each of the countries of the world shows that the application of electronics information technology to advance the intensive transformation of traditional industries is the key for economically fairly backward countries in catching up with developed countries. The use of electronics information technology to transform traditional industries means combining intellectual output with material output, emphasis on enormously increasing the material resources utilization rate, raising the added value of products, increasing the labor productivity rate, and increasing the role of information in the economy.

One of the main reasons for the lack of intensiveness in China's economy is the overly low electronic information technology content in the industrial structure. Use of the three main resources—energy, processed materials, and information—is uneven. The development and use of information resources is lacking. Today, nearly one-fifth of the equipment in the country's industrial enterprises is old. In large and medium size state-owned enterprises, the old equipment rate is 25 percent, 39 percent of the equipment having exceeded its intended period of service. Of the 941 large and medium size enterprises in China's old industrial base, Liaoning Province, 604 were built during the 1950's. Except for 38 that have been completely technologically transformed, the equipment in all of the remainder is the same as it always has been. This equipment wastes a large amount of energy and materials; its production efficiency is low. Its processing precision and reliability are unable to satisfy today's socio-economic development requirements. Therefore, use of new technology to transform traditional industry has become a step that will brook no delay.

2. The Application of Electronics Technology To Transform Traditional Industries Is an Effective Means of Improving Social Productivity

If one says that the industrial revolution symbolized by the steam engine was an extension of human physical energy, then the new technological revolution symbolized by microelectronic technology and computers is an extension, an expansion, and an enlargement of human intelligence whose appearance has fundamentally transformed mankind's way of life and production methods. Since electronics information technology diffuses and spreads easily, and since it can be blended extremely easily with other technologies to derive new technologies and new industries, in addition to which electronic technology products are themselves smart, highly reliable, and low loss products that conserve materials, energy, space and manpower, in addition to which their added value is high, their application to traditional industries can bring about a sudden fundamental change in the face of the economy.

In recent years, China has used classic pilot projects for the gradual spread of electronics information technology into the metallurgy, construction materials, chemical industry, electric power, railroad, and finance and banking sectors. Marked economic returns have been obtained through the improvement of product quality, conservation of energy and materials, and improvement of the labor productivity rate.

In the metallurgy field, Anshan Steel used electronics technology in the transformation of 129 furnaces for an average 10 percent saving of energy that increased annual returns by approximately 28.6 million yuan. Transformation of the steel rolling heating furnace permitted an average annual 886 tons per furnace reduction in oil consumption, a saving of 60,000 cubic meters of natural gas, and a saving of 713 tons of processed steel.

In the construction materials industry, approximately 20 percent of cement plants above the county level have applied computer technology to control the vertical kiln production process for an annual saving of 540,000 kwh of electricity, a 756,000 tons saving of coal, a 5.4 million ton rise in output, a 30 to 50 grade rise in cement quality, and a 10 to 15 percent decline in coal and electricity consumption per ton of cement. If the technological transformation of all cement plants above the county level can be completed during the Eighth 5-Year Plan, more than 10 million tons of coal can be saved annually.

In the chemical fertilizer industry, use of electronics technology to transform chemical production produced a 13.2 percent increase in output and a 13.8 percent energy saving from the automatic regulation of the ratio of hydrogen to nitrogen alone. Following technological transformation, the Sichuan Chemical Fertilizer Plant's energy consumption per ton of synthetic ammonia declined nearly one-half.

In the transformation of industrial furnaces, the use of electronics systems for heat treatment control improves heat efficiency between 5 and 10 percent and lowers energy consumption more than 10 percent. Statistics show that nearly 500,000 industrial furnaces account for nearly half the country's coal consumption at the present time. This is approximately 500 million tons. Only 10 percent of these furnaces have been transformed, so the potential is tremendous.

In the electronics industry, Zhengzhou City applied an automatic load control system for the optimization of electric power allocation. After one-half year of operation to regulate electricity use in 15 percent of the city, it has reduced power cutbacks 35 percent recouping 15 million yuan in power grid economic losses.

In the transportation and communications field, after railroads nationwide installed computers and scheduling networks, the railroad car turnaround time was shortened 25 percent, thereby permitting the hauling of an additional 60 million tons each year. The freight control system at the north marshalling yards in Zhengzhou showed direct economic returns of 86.78 million yuan. Social benefits realized from the hauling of more coal alone can produce an additional 21.5 billion yuan in industrial output value. Annual maintenance of China's 1.02 million kilometers of railroad track costs 10 billion yuan annually. Now that computers have begun to be used in the railroad maintenance management system, a saving of 1 billion yuan in maintenance costs has been realized.

In the machine industry, Liaoning Province technologically transformed its old machine tools. While improving processing precision, it also boosted work efficiency between 20 and 40 percent. This improvement alone increased economic returns throughout the province by 48 million yuan. China has nearly 3.2 million cutting machine tools of one kind or another, the largest number in the world, but more than 90 percent of them

are ordinary machine tools. High technology, precision and sophisticated machine tools number fewer than 10 percent, and digitally controlled machine tools number only 3 per 10,000.

Representative analysis shows a relatively high input-output ratio in the use of electronics technology in the transformation of traditional industries. The ratio is frequently greater than 1 to 4, and in some fields it reaches 1 to 10 or even higher. In the Jinan Iron and Steel main plant in Shandong, for example, a computer controls the steel sheet rolling machinery. A total of 20 million yuan was invested in equipment having a 250,000 ton designed capacity, but thanks to the computer control, actual annual output is 400,000 tons, thereby increasing output value by 150 million yuan, and taxes and profits by 60 million yuan in a 1 to 30 return on investment. In the technological transformation of the electric power industry, a rough estimate shows that for every kilowatt of electricity an investment in electronics technology of only 600 to 1,200 yuan is needed; however, the building of new power plants having the same capacity requires an investment of 2,700 yuan per kilowatt for thermal power plants, and 4,000 yuan for hydropower plants.

The foregoing actual examples show that China's application of electronics technology to the transformation of industry has produced substantial returns, and that prospects are extremely wide. It is well worth doing.

3. Main Problems in China's Use of Electronics Technology in the Transformation of Traditional Industries

Despite the achievements made in China's use of electronics technology to transform traditional industries, a very great gap still exists between what has been done and both the needs of traditional industries and the world advanced level. For example, at the end of the 1980's, the United States began to use computer integrated manufacturing (CIM) technology whereby the entire process of design development, planning, production, and quality control became a continuous computer-assisted information flow. Thus the flow of materials and information within business firms became highly linked and automated. Production efficiency increased between 40 and 70 percent; engineering costs fell between 5 and 30 percent; the new products development period was narrowed between 30 and 60 percent; and the equipment effective utilization rate rose between two and three times. The level in Japan is equal to that of the United States. Faced with the challenge of the international new technology revolution, we must earnestly study the problems and difficulties in China's application of electronics technology to the transformation of traditional industries, and seek solutions to accelerate progress in this work.

China's problems in the application of electronics technology to the transformation of traditional enterprises are in the following four regards:

(1) The problem of a double gap in both traditional industries and the electronics industry

Both China's traditional industries and its electronics information industry are facing the twin tasks of industrialization and applying information. On the one hand, traditional industries are unable to satisfy needs for development of the electronics industry itself in terms of their level of processing, quality of raw and processed materials, and the quality of the work force. At the same time, the level of China's existing electronics industry cannot very well serve in the technological transformation of traditional industries whether in the level of product technology, product quality, the industrial structure, and the make-up of products. It is particularly weak in reliability of component parts as well as in engineering support and systems coordination capabilities. This gives rise to a whole series of problems, such as conflicts between the increase in scale and intensive transformation, the orientation of production policy, and the direction and degree of tilt in investment, which add to the difficulties.

(2) The problem of whether to import or develop native industries

Because of this "double gap," a conflict exists in development of the country's industry between whether to import industry or develop it ourselves. In the electronics industry, since China lacks the requisite processing technology as well as the equipment and materials, it has no choice but to import large amounts of technical equipment and materials from abroad. In traditional industries, since the electronic technological equipment needed cannot be provided from inside the country, it is necessary to purchase large numbers of whole plants each year. As a result, both kinds of industries lose markets they should have, which restricts the possibility of developing our own industries. Consequently development of both is limited. In particular the duplication of imports is extremely serious, occasioning very great problems and difficulties for the healthy development of both traditional industries and the electronics industry. A large socialist country such as China cannot buy modernization. Genuine industrialization and application of information requires not only imports but emphasis on self-development for the building of a national industry rooted in China.

(3) The problems of building an operating mechanism suited to industrial progress and the drawing up of an attendant equipment policy

The application of electronics technology to the transformation of traditional industries is an enormous systems engineering project that no sector can take on by itself. Therefore, full expression must be given to the national will, vigorous coordination and cooperation among all industrial sectors emphasized.

First of all, how can system reform be intensified for the building of an operating mechanism that helps combine economic development with progress in science and

technology? At the present time, one-sided emphasis is given to output value in development of the country's economy. A tilt toward blind pursuit of speed continues to exist. This, together with the separation between one sector and another and the separation between higher and lower administrative levels readily gives rise to a tendency to emphasize size while slighting transformation. This causes a repetition of production at a low level, which creates hardships for macroeconomic planning. Therefore, study must be given to the fashioning of an operating mechanism that advances technological progress in enterprises to guide enterprises toward a path in which returns rather than output value are central.

(4) The "interface" problem in the application of electronics technology to the transformation of traditional industries

The application of electronics technology to the transformation of traditional industries is a multifaceted project that cuts across sectors and industries, and in which large numbers of "interface" problems exits in actual operation. Examples include the "interface" between electronics technology and traditional specialized technologies; the "interface" between the electronics system and the traditional industry system; the "interface" between technical standards in different industries; the projects and funds "interface" among different sectors; the market "interface, as well as the human talent "interface" and the service "interface" between the development of electronics technology and its application to traditional industries. These interface problems, whether large or small, and which have a direct effect on carrying out the technological transformation of traditional industries, must be regarded seriously. In a nutshell, the so-called "interface" problem is essentially a problem of a new industrial layer that links electronics technology with traditional industries. Such a new industry is a systems engineering and information service industry that lies between the electronics and traditional industries and devotes efforts to systems integration, software development, information services, training and maintenance, and the spread of new technologies to application, etc. in order to solve various "interface" problems. Clearly, only the formation of a new industrial layer can provoke thinking and solution about this problems in a unified way so that one matter is not forgotten in the course of paying attention to another. Achieving this cannot be done by depending on the either the electronics industry or traditional industries to do it themselves independently. Everyone must join hands for joint promotion of the formation of a new industry.

How to Meet High-Technology Product International Competition

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[Article by Xu Shibin [1776 0013 2430] and Du Xiangying [2629 4382 3841], State Science and Technology Commission Office: "Factors Limiting the Entry Into International Markets of China's High-Technology Products and Ways of Coping With them"]

[Text] One marked feature of modern world economic development is the increasing economic association and increasingly close economic contacts among nations. As a result of unbalanced economic and technological development, which increases interdependence among nations, the international division of labor is steadily readjusting and intensifying. This also promotes a further expansion of the scale of international commodity exchange.

Since the advent of the 1990's, in order to gain the political, economic, and technological initiative, each of the countries of the world has put more effort into drawing up a turn-of-the-century development strategy for the final 10 years of the present century. They have adopted measures to expand their share of international market export trade. In view of this situation, analysis of the composition of China's export products, and the formulation of a foreign economic relations and trade development strategy that is in keeping with national circumstances assumes extremely great importance.

During the 1980's, China completed the first change of its export products, i.e., it changed from the export of mostly primary products to the export of industrial manufactures. However, according to World Bank "comparative trade price" statistics for each country, China's foreign trade comparative prices have shown a downward trend in recent years, the degree of rise in import prices showing marked contrast to the degree of rise in export prices. This deterioration of the trade situation is related not only to the imbalance in international trade conditions as well as China's beginning and ending the production process for many products on the international market, i.e., importing raw materials and exporting finished products, in recent years, and the suppression of prices resulting from competition, but more importantly it is closely related to the second-rate level of management, product quality, and product technology in China's export enterprises. Customs statistics and a large amount of research data show that the lackluster make-up of China's exports has become a primary factor limiting development of the country's exports. Improvement of the technology content of export wares and increasing the export of high-technology products is an urgent task.

The percentage of China's exports that incorporate high-technology to increase value is still relatively small. Every year, China exports large amounts of low-priced ordinary goods that foreign traders transform, make over, or fit out with high-technology items, reassembling or reconstituting them. This means that they command prices in the international market that are several times higher than the original product price, thereby reaping huge economic returns. A substantial quantity of products are resold in China. As a result of this exporting and importing, foreign traders make substantial added value from technology.

Admittedly, the technological level of China's industrial production is still not high. We must still learn certain sophisticated technologies from the developed countries of the world, and import certain key facilities, key parts, and associated products. Nevertheless, we positively cannot overlook the fact that after more than 40 years of construction, China has fashioned a fairly complete industrial system whose scale of production and technological level have developed by leaps and bounds. During the past decade, in particular, China's high-technology exports have increased year by year as a percentage of its total foreign trade exports. Consequently, in view of the large capacity of the world high-technology products market and the intense competition, active development of China's high-technology products that possess certain advantages for timely entrance into the international market will greatly change China's export trade situation.

Factors Limiting the Entry Into International Markets of China's High-Technology Products

1. At the present time, the developed countries of the world occupy an overwhelming majority of the high technology product markets. The United States, Japan, and the countries of Europe work hard to ensure the development and expansion of their own share. Newly industrializing countries and regions that are changing from the export of low-technology products to the export of high-technology products do their utmost to get into the high-technology international market.

In recent years, the labor wage index of each of the advanced industrial countries has risen steadily. What with the labor shortage, the production of traditional products is no longer profitable; thus, all countries are putting more effort into the readjustment of their industrial structure, gradually transferring labor-intensive and resources-consuming products to developing countries so that they can export more high-technology products and import low-priced primary products and labor-intensive products. Developing countries labor under an unfair international division of labor fashioned by history. The trade conditions that they face get worse and worse, and their export of high technology products faces a grim and unfavorable international environment. In addition, the appearance in developed western nations in recent years of an economic depression has also resulted in their not being able to open more high-technology product markets to us.

2. As competition from western countries increases, and more regional economic blocs are formed, trade protectionism has intensified further. Technological barriers have become one of the most thorny issues in international trade today.

Since the beginning of the 1990's, technical barriers have increased rather enormously as a percentage of non-tariff barriers in international trade. The percentage of technology-intensive products and high-technology products in world trade has increased greatly, making this problem more complex. Examples include: technical standards, laws, commodity packaging and labeling regulations, quality certification, measuring standards and variety, specifications, style, and external appearance standards, etc. Countless technical limitations very greatly affect and limit developing countries export trade.

As a result of the limitations of the level of production in China's enterprises and the lack of strict quality controls, the certification system is not yet on a sound footing. The export of goods suitable for different markets not only requires numerous repeated checks, which drive up export costs, but this may also easily give developed countries a pretext for taking action to restrict imports of China's commodities. This causes real losses and poses a potential threat to the export of China's high-technology products.

3. China's internal circumstances suggest that its high-technology industries are still in a preliminary stage. High-technology projects account for a small percentage of total sales, and development is slow. Although China's high-technology products have begun to enter the international market in recent years, the technological quality of most exports remains fairly low; exports of truly high quality high-technology products is minuscule. Competitiveness of China's high-technology products in international markets is fairly low. Getting a decent return on them is difficult.

In addition to the foregoing limiting factors, numerous unfavorable factors exist in the promotion of achievements made in research as well as in the commercialization and industrialization of products. Examples include the following: too long a time period from the time a research achievement is made to its application to production, and from production to marketing. Funds for the commercialization, industrialization, and internationalization of high-technology research results cannot be assured, or a definite place where such work is done cannot be found in the various levels of planning for scientific and technical development or economic development. Solution to this problem must await constant intensification of reform of the economic system and the science and technology system.

China's High-Technology Products Export Development Strategy and Measures

1. As a result of the complexity of the production structure and the multiplicity of types of consumption in the various countries of the world, the world high-technology market exhibits different levels of demand. The technology content and intensivity within high-technology products may be very different for different countries. This provides room for maneuver for the products of each of the countries of the world. In addition, the changes taking place in the kinds of industries and readjustments of the industrial structure in developed countries, and in newly developing industrial countries and territories also afford opportunities

for developing nations. China has abundant manpower resources and wages are low. For some time to come, the development of labor-intensive and technology-intensive productions for export will continue to hold advantages from which substantial returns can be realized.

2. In view of China's national circumstances and the international climate, to take part in high-technology product international market competition would not be prudent. A comprehensive appraisal of the export market based on diligent investigation and study of the international market must be made to select the product areas in which the country holds advantages and in which ready marketability abroad exists to accelerate commercialization and gradually open up sales channels. The guiding and regulatory role of policies and economic levers must be used to the full to create conditions for the development of markets.

Survey analysis shows that during the next several years, western market demand for investment-type machinery and electrical appliances will be substantial, and prices exhibit a trend toward stability with slight rise. The Commonwealth of Independent States, and the countries of eastern Europe have increased their reliance on the international market following changes in the political situation. Demand for consumer type electronic products, and certain light industrial wares is urgent. As a result of their political situation and their economic and technological foundations, the developing countries of Latin America and Asia express considerable interest in China's medium quality high-technology products such as video monitors, computers and peripherals, precision machines, and certain electronic video and audio equipment.

3. Products are the carriers of technology; they are also the means and the tools for the realization of technology. Trade in products and technology plays a mutually stimulating role. We must take a road that combines technology and trade, using technology as a chip to spur product exports. When exporting various specialized technologies, patents, technology documents, and drawings, contracts should, insofar as possible, also contain clauses for the export of hardware such as processing equipment, supplementary equipment, and production lines. When whole machines are exported, contracts should also include provisions to supply associated semi-manufactures and spare parts, whole machines serving as a vehicle for the export of spare parts.

4. China possesses numerous mineral resources in abundance that other countries lack such as rare earths. Many cities possesses multiple technical and regional advantages, and full use can be made of China's advantages in manpower, skills, and resources for the gradual creation of distinctively Chinese high-technology industries. Serious attention must be given to infiltrating high technology into traditional industries, to greater building of export bases, to improvement of management, and to increasing the new industrial development capacity of basic enterprises and enterprises having enlarged authority for the gradual upgrading and updating of conventional products, winning a world market reputation by imbuing name brand products with new meaning.

5. The continued digestion of technology imported during the Seventh 5-Year Plan should be used as a springboard for increasing Chinese-made products, encouraging enterprises having requisite conditions to take active part in international competition (such as submitting international tenders for technology-intensive products, organizing production in accordance with advanced international standards), using the draw of international markets to accelerate the growth and development of China's high-technology industries. In the realm of sales strategy, the focus must be on technology-intensive products, the expansion of cooperation with the outside world, the adoption of flexible and diverse trade and sales strategies (such as the founding of super-national corporations to assemble Chinese-made semi-manufactures and parts in foreign countries for local sale) to move directly into the high-technology international market.

Norms for Judging Investment in Science and Technology

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[Article by Ding Houde [0002 0683 1795]: "China's Norm System For Investment in Science and Technology and Rules For Testing It"]

[Text] Science and technology is the primary production force, and investment in science and technology provides the financial support for scientific and technical activity. It is investment of a productive nature. Investment in science and technology plays an extremely important role in translating science and technology into real productivity. Consequently, increased investment in science and technology is a universal law in international society. Increasing its investment in science and technology is an urgent choice facing China. Providing a system of norms for overall investment in science and technology is a necessity for macroeconomic regulation and control and policy decisions, and it is also a necessity for the development of China's science and technology management theory.

1. Changes in the Make-Up of China's Investment in Science and Technology

Many years of reform of the science and technology system and the economic system have wrought changes in the make-up of China's investment in science and technology. This demonstrates new development of the country's science and technology operating mechanism, and a benign cycle that links science and technology to the economy. Investment in science and

technology no longer relies solely on disbursements from the national treasury; instead an investment pattern is beginning to take shape in which the entire society invests in science and technology.

Statistical data show a trend toward decline in government investment in science and technology in China, and a trend toward rise in non-government investment. (See Table 1)

Table 1

Year	Government Funds		Non-Government Funds		Total
	Amount	Percent	Amount	Percent	
1987	11.574	62.1	7.074	37.9	18.648
1988	11.8	52.9	10.516	47.1	22.316
1989	12.789	49.0	13.292	51.0	26.081
1990	13.66	45.4	16.401	54.6	30.061

Units: Billion Yuan

Currently, most non-government investment in China comes from the self-provided technical development funds of large and medium size enterprises, the self-provided funds of research institutions, and the self-provided funds of institutions of higher education. Awards are also provided through other channels and means. Table 2 shows the status of investment of the three types of non-government funds invested in science and technology.

Table 2

Year	Research Institutions		Enterprises		Institutions of Higher Education		Total
	Amount	Percent	Amount	Percent	Amount	Percent	
1987	28.02	39.6	42.32	59.8	0.40	0.6	70.74
1988	40.88	38.9	63.93	60.8	0.35	0.3	105.16
1989	53.78	40.5	78.42	59.0	0.72	0.5	132.92
1990	66.66	40.6	96.47	58.8	0.88	0.6	164.01

Units: 100 Million Yuan

Table 2 shows that self-provided funds from large and medium size enterprises made up the largest percentage, accounting for approximately 60 percent of the total that large and medium size enterprises, research institutions, and institutions of higher education provided. Research institutions stood second at approximately 40 percent.

In society's investment in science and technology, the link-up of science and technology with finance provides the prospect of a fine future. Loans for science and technology are the main form of link-up between finance and science and technology. As part of the overall national credit plan, the Chinese People's Bank has set up a science and technology development credit category, and has increased tremendously the scale of credit. During the past several years, the Chinese People's Bank and specialized banks concerned have made provisions for approximately 7 billion yuan of credit for science and technology, and actual loans made already top the amount provided for. (See Table 3).

Table 3

	1987	1988	1989	1990
Amount of Bank Credit			1.5	2.89
Actual Bank Loans	4.278	4.885	4.088	6.12

Units: Billion Yuan

Science and technology loans provide marked economic and social returns. According to Chinese Industrial and Commercial Bank statistics, loans totaling 6.64 billion yuan have been issued since science and technology loans were initiated in 1984 until the end of 1989. These loans produced a new output value of 17.36 billion yuan, profits and taxes of 3.14 billion yuan, and the creation or saving of 1.807 billion yuan in foreign exchange. Statistics on loans for science and technology by the country's 43 provinces and municipalities show a 1 to 3 input-output ratio, economic returns being higher than from other kinds of loans.

In summary, marked changes have occurred in the make-up of China's investment in science and technology, a new pattern of investment in science and technology by society as a whole having taken preliminary shape. The investment of finance capital (funds provided for compensation) through state financial disbursements for science and technology, investment in

science and technology of funds that enterprises, research institutions, and institutions of higher education have themselves provided, and bank loans for science and technology have become the three main pillars for investment in science and technology in China. In the future, it may be possible to attract venture capital investment, risk capital investment, finance capital from the sale of securities, individual and fund contributions, and foreign bank capitalization to make the investment structure more complete.

2. Establishment of Overall Macroeconomic Norms for Investment in Science and Technology in China

China has yet to establish a national level overall macroeconomic norms for investment in science and technology. The announced nationwide norms for investment in science and technology are norms that lump together cultural and educational, scientific, and health work. Such criteria, in which various endeavors are jumbled together with no set limits among them, holds no real significance in analyzing and evaluating trends. An alternative is specific item norms such as expenses for scientific endeavors, the three expenses (intermediate trial expenses, new product trial manufacture expenses, and major scientific research project supplementary expenses), scientific research capital construction expenses, and scientific research expenses. Although specific item norms are an important basis for evaluating management at the present time, they do not reflect structural changes in investment in science and technology. In macrocontrol and decision making, they do not provide a sufficient overall understanding of investment in science and technology. Furthermore, the aforementioned two kinds of norms are difficult to establish and compare with international science and technology norms.

It is customary international practice today to use the ratio of a country's R&D expenses to its GNP (i.e., expenses for research and development activities as a ratio of gross national product) as a yardstick for judging the intensity of investment in science and technology. This is a uniform science and technology norm that can be compared internationally. The United National Education and Science Committee (UNESCO) regularly publishes systematic science and technology norms represented by R&D. China has not yet formally provided international organizations with related scientific and technical statistical data. This ill befits China's international position; thus, the establishment of such norms and their publication is entirely necessary and urgent for China.

The establishment of overall science and technology norms for China, and unifying the terms used for expressing investment in science and technology is a research task that the highest decision-making level of the Party and state have proposed for the purpose of increasing investment in science and technology in order to move ahead conscientiously with the four modernizations. They have also stipulated that the increase in national investment in science and technology is to be greater than the increase in GNP.

The overall macroeconomic norms for investment in Chinese science and technology must perform the following functions. First, they must be consistent with China's national circumstances and also permit international comparison. Second, they must genuinely reflect the total and relative amounts of investment in science and technology nationwide; third, they must include key norms that can regulate and control the overall situation and play a guiding role; fourth, they must reflect structural changes in investment in science and technology; fifth, they must contain an operational and quantifiable statistical data support system; and sixth, the quantified numerical values that the norms indicate must be checkable (i.e., provide norms for testing), and be able to serve in regulation and control, as well as decision making.

In this regard, the following norm [graphic not reproduced] system has been designed:

The four major norms are analyzed below:

(1) All Science and Technology Expenses

This includes the total value of payments for science and technology. It embodies the amount of money obtained for all scientific and technical activities in China, including both government and non-government funds. Since outlays may be either compensated or uncompensated, the total value of outlays for science and technology may be understood in two different ways as follows: First is to distinguish between uncompensated and compensated funds (not including loan funds for science and technology for which compensation is paid), namely the sum of government and non-government funds. Second is not to distinguish between compensated and uncompensated funds, namely the sum of government funds, non-government funds, and science and technology loans. In this norm system, total expenses are according to the first understanding. The features of the all science and technology expenses norm system are as follows:

(1) It enables national regulation and control, and decision-making organs to obtain the numerical amount of total investment in science and technology nationwide, and to obtain a grasp of the sources and make-up of all outlays. It has a clear macro-decision making function.

(2) It reflects structural changes in the nation's multichannel, multiform, and all-points investment by society as a whole in science and technology.

(3) It reflects major changes in China's science and technology operating system. Currently, non-government funds fund half of all science and technology expenses in China, and the self-provided funds of research institutions account for 40 percent of all non-government funds. This shows that the operating mechanism comprised of a link-up of science and technology with the economy is entering a benign cycle period.

Table 4 provides statistics on the self-provided funds of research institutions nationwide for 1989.

Table 4

Subordination Relationship	Gross Income From Scientific Research Activities (Billion Yuan)	Including Income From Technology (%)	Proportion of Scientific Operating Costs Paid For by Gross Income From Scientific Research Activities
Scientific Research Units Nationwide	5.03	80	1.7
Including: (1) Central Government Research Units	35.6	80	2.1
(2) Local Government Research Units	1.47	67.2	2

(2) R & D Expenses and Ratio Between R & D and GNP

R&D expenses, and particularly the ratio between R&D and GNP are internationally widely used indicators. They are representative and authoritative norms in internationally exchanged information about investment in science and technology. UNESCO regularly publishes these norms for approximately 80 countries. Therefore, completion of research on China's R&D outlays, and formally publishing figures for these norms will both permit international exchange, and will also show that China's investment in China's science and technology has entered a new stage of scientific management.

R&D is the creative and innovative part of scientific and technical activity. Support for R&D shows the intensity of China's investment in science and technology to support scientific and technical creativity and innovation.

An inherent law of R&D enables R&D to be broken down into basic research, applied research, and trial development, as well as the subsequent translation of R&D results into applied activities in the joint formation of a continuous development series. R&D plays an important role in translating science and technology from an intellectual formulation production force into real productivity. The make-up of investment, proportions, and speed in the continuous development system, as well as their relationship to the three main pillars for investment in science and technology, and their relationship to research institutions are problems that macrocontrol and regulation and control must address and solve. Therefore, R&D expense norms are not only norms commonly used in international exchange, but they are also macrocontrol and decision-making norms for regulating and controlling internal relationships in scientific and technical activity, as well as their coordinated development with the external economic and social environment.

(3) State Disbursement of Funds For Science and Technology

State disbursements of funds for science and technology are payments out of the national fiscal budget. In terms of prevailing state fiscal budget categories, government disbursements are listed as the portions of the three science and technology expenses (intermediate trial expenses, new product trial manufacture expenses, and major scientific research project supplementary expenses), scientific activity expenses, and capital construction expenses used in scientific and technical activities. In future national financial budget payments, a general category for state disbursements for science and technology must be established with a sub-category for the listing of scientific research capital construction expenditures, thereby fashioning a complete budget category for state disbursements for science and technology as a means of assisting macro-regulation, control, and management.

Since reform of the science and technology system, structural changes have taken place in the country's investment in science and technology. The ratio between the investment of non-government and government funds is on a par. Nevertheless, the investment of non-government funds cannot take the place of the investment of government funds. The main part of the development of state science and technology endeavors such as the national science and technology development strategy and its composition must be founded on state funding of science and technology. Thus, the investment of government funds plays a guiding and principal role in overall investment.

Scientific research organs under ownership of the whole people are the main force in China's scientific and technical endeavors. The science and technology expenses that the state pays for through the disbursement of science and technology funds provide the economic conditions for their existence and development. Government disbursements to these research organs account for 80 percent of all disbursements to them. Changes in, development of, dispersal and reconstitution of the scientific and technical personnel corp in scientific research organs also depends on state financial disbursements for science and technology as a means of regulation and control.

China is a developing socialist country employing an operating mechanism that combines a plan economy with market regulation. State disbursements for science and technology are plan disbursements that are included in state fiscal budgets and final accountings, that are subject to the supervision of people's congresses at all levels. They are a consistent investment in science and technology whose percentage and speed of increase is subject to examination. The key element of what we ordinarily term a increase in the country's investment in science and technology is state investment in science and technology as a percentage of increase and the speed of development of national fiscal revenues, fiscal expenditures, and GNP.

(4) Science and Technology Loans

Science and technology loans are the main source of funds to support the translation of R&D results into applied activities. It is the main realm of structural changes in China's investment in science and technology. For a long period of time, China has not supported investment in science and technology for the entire science and technology activity process. First it supported investment in research on R&D activity; then it supported investment in production funds for technological transformation; however, investment in the translation of R&D results into real productivity was basically an investment void. This did not make sense. Now the People's Bank has set up a science and technology development loan category, tremendously increasing the size of loans. From now on, this fusion of science and technology with finance will be an area of very great vitality. The establishment of science and technology loan norms is very necessary and feasible.

3. Examination of the Overall Norms for Investment in Science and Technology in China

China's overall norms for investment in science and technology have both a regulation and control and a decision-making function. The quantified numerical value of norms must be checkable; it cannot simply depict the current status, but must have requirements that must be met in the realization of goals. The establishment of objective, scientific, and serviceable criteria for examination is for the purpose of validating the reasonableness of overall norms for investment in science and technology. The following examination criteria scheme is provided for the aforementioned four main criteria. It is offered for the consideration of authorities in charge.

(1) Criteria For Testing All Science and Technology Expenditures

Examination criterion 1 - Increase in government and non-government funds at substantially the same pace.

During the past several years, government and non-government funds have each accounted for approximately 50 percent of total expenditures for science and technology in China. This proportional relationship is substantially the same as for most large countries in the world.

Increase in government investment funds can only be based on national disbursements for science and technology. This is the government's only direct investment. Government preferential policies to spur the development of scientific and technical endeavors in the form of tax reductions and concessions, and encouragement and nurture of the development of scientific and technical endeavors that enable enterprises, research institutions, and institutions of higher education to increase their extrabudgetary income, and to be able to apply it as some of the self-provided funds needed for science and technology has become an integral part of the investment in science and technology by the society as a whole. Nevertheless, none of these means should serve as direct government investment in science and technology.

(2) Criteria For Examining R&D Expenses and the Ratio Between R&D to GNP

Examination criterion 2—R&D Expenses and the Ratio Between R&D and GNP.

This is a criterion in general use internationally. Two main methods are used to figure R&D expenses. One is the macroinvestment method; the other is the microexpenditure method (also known as the internal expenditure method). This article employs the macroinvestment method to calculate China's R&D expenses, and to obtain the radio between R&D and GNP as shown in Table 5.

Table 5

Year	R&D Expenses	GNP	R&D/GNP
1987	90.18	11,301	0.79%
1988	100.92	13,984	0.72%
1989	113.88	15,789	0.72%
1990	125.73	17,400	0.72%

Units: 100 Million Yuan

China's ratio of R&D to GNP is in the mid range of developing countries, and obviously should be raised. Table 6 shows the ratio of R&D to GNP for some developed countries and developing countries for comparison purposes.

Table 6

Country or Territory	Year	R&D/GNP
Canada	1986	1.5
United States	1986	2.8
Japan	1986	2.8
Finland	1987	1.8
France	1986	2.3
West Germany	1985	2.7
Italy	1986	1.2
Sweden	1985	3.0
U.K.	1986	2.3
Hungary	1987	2.7
South Korea	1986	1.8
Portugal	1986	0.5
Egypt	1982	0.2
Brazil	1985	0.4
China	1990	0.72
India	1986	0.9
Singapore	1987	0.9
Kuwait	1984	0.9
Chile	1987	0.5
Thailand	1985	0.3

(3) Criteria For Testing Government Disbursements for Science and Technology

The following three plans or combinations thereof may be used as criteria. These three plans are termed testing criterion 3.1, testing criterion 3.2, and testing criterion 3.3.

Testing criterion 3.1: Increase in state disbursements for science and technology should be higher than the increase in regular government fiscal revenues. This is spelled out in *CPC Central Committee Decisions on Reform of the Science and Technology System.* Many years of practice have shown that the sense of "regular" must be made clear; otherwise the criterion loses significance.

Testing criterion 3.2: Increase in state disbursements for science and technology must be greater than the increase in GNP..

Testing criterion 3.3: Increase in state disbursements for science and technology must be greater than the increase in state fiscal expenditures.

Table 7 shows base figures for the growth rate of state disbursements for science and technology during different periods in China, and the ratio to the rate of increase in national fiscal revenues, national fiscal expenditures, and GNP.

Table 7

Period	Rate of Increase in State Expenditures for Science and Technology	Rate of Increase in State Fiscal Revenues	Rate of Increase in State Fiscal Expenditures	Rate of Increase in GNP
First 5-Year Plan (1953-1957)	1	0.166	0.175	
Second 5-Year Plan (1958-1962)	1	0.097	0.144	
Three Years of Economic Hardship (1963-1965)	1	0.570	0.586	
Third 5-Year Plan (1966-1970)	1	1.369	1.315	
Fourth 5-Year Plan (1971-1975)	1	0.640	0.722	
Fifth 5-Year Plan (1976-1980)	1	0.631	0.854	
Sixth 5-Year Plan (1981-1985)	1	1.171	0.916	1.389
Seventh 5-Year Plan (1986-1990)	1	1.736	1.911	2.536

Table 7 shows a rate of increase in government disbursements for science and technology during the First 5-Year Plan, the Second 5-Year Plan, and the 3 year period of economic hardships that was several time the rate of increase in state fiscal revenues and state fiscal expenditures (GNP figures were published only after 1978). However, a marked contrast occurred during the sixth and seventh 5-year plans when the rate of increase in state disbursements for science and technology was universally lower than other rates of increase. These data contain profound connotations meriting extremely serious consideration. The data for the period prior to 1965 basically reflect the period of the *1956-1967 Long-Range Plan For Development of Science and Technology Nationwide* when the scale of state disbursements for science and technology assured a take-off in investment in expenditures for "two bombs and one satellite". The scale of expenditures during the sixth and seventh 5-year plans was inconsistent with the scale of investment in science and technology of *CPC Central Committee Decisions on Reform of the Science and Technology System. This is a conclusion derived from the checking standards.*

(4) Criteria For Testing Science and Technology Loans

Testing Criterion 4: Science and technology loans as a percentage of total national credit plan.

Science and technology loans applies to the amount of Chinese People's Bank loans for science and technology. Thus, testing criterion 4 should be the ratio of the amount of bank credit for science and technology to the total amount of the state comprehensive credit plan. This ratio can be validated and confirmed.

University Research Should Benefit Economic Construction More

92FE0503D Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 2, Mar 92 pp 29-32

[Article by Que Weiming [7067 4850 2494]: "Cursory Discussion of the Science and Technology Operating Mechanism in China's Institutions of Higher Learning"]

[Text]

1. The Science and Technology Operating Mechanism Is an Important Support Structure for Socio-Economic Development

By science and technology operating mechanism is meant all the separate links that comprise innovative scientific research and development activity, and the various factors in the environment in which they are located (including the system, policies, conditions, management, and human talent), the methods used to link them together, and the interacting chain-actuation process. Of the three key factors in the process of moving

ahead in science and technology—human talent, the mechanism, and inputs—the mechanism is the truly crucial one. Since the science and technology operating mechanism not only determines the inherent make-up of scientific and technical activity itself but also determines the role of social environment factors, it conveys a distinctive flavor and social characteristics of the time. Because of differences in their political system, point of view, economic development, society and culture, different countries and territories in different times have produced and shaped operating mechanisms having different characteristics. The science and technology operating mechanism is an integral part of mutually limiting relationships in all realms, all parts, and all levels of society as a whole; it is one of the increasingly important support structure for socio-economic development. In fact, during this new historical period in which technological progress increasingly mirrors the guidance of scientific theories, and in this new historical age in which social production and economic development depend increasingly on scientific and technical progress, the science and technology operating mechanism exhibits more and more a crucially important role.

The science and technology mechanism serves to link the system structure. Benefits limiting mechanisms, regulation and control mechanisms, guidance mechanisms, and excitation mechanisms frequently seen in daily life are constituent parts of this operating mechanism. When these parts are not sound and integrated, imbalance in the entire science and technology operating process may frequently result. An unbalanced science and technology mechanism not only is unable to give impetus to scientific and technical progress, but it may also adversely affect or impede the rise and development of certain specific processes for historical progress. Among the numerous constituent parts of the operating mechanism, the benefits limiting mechanism is the key one. It is the basis for all operating mechanisms, and it is also the foundation that permits all operating mechanisms to operate. A science and technology operating system that is filled with vitality will inevitably be a dynamic operating mechanism, and a benefits limiting mechanism is an important foundation for the construction of a dynamic mechanism.

2. Basic Features of the Institutions of Higher Education Science and Technology Operating Mechanism

The scientific and technical work of institutions of higher education is conducted in an environment for the education of people. Because of the role of limiting factors in this environment, its operating mechanism shows markedly distinctive features. First is that scientific and technical work began relatively late in institutions of higher education. During the period immediately following founding of the new China, there were fewer than 100 full-time teachers per school in the nation's 205 institutions of higher education. This was fewer than the number in an ordinary middle school today. They were unable to conduct scientific research in addition to their teaching duties. This historical situation shows that from the very beginning institutions of higher education did not keep up with historical progress in the development of a socialist economy. They did not become a support structure giving impetus to this historical progress. Thus, the direct effect of economic construction on scientific and technical work in institutions of higher education appeared weak, and institutions of higher education seemed ill-informed and obtuse about the scientific and technical needs of economic construction. Second, scientific and technical work in the nation's institutions of higher education developed during the high tide of the building of socialism during the late 1950's when the building of socialism required large numbers of high level specialists to give impetus to the unprecedented development of higher education. However, expansion and improvement of the teaching corps of institutions of higher education relied on the methods of scientific research. Thus, scientific and technical work in institutions of higher education was the original point for nurturing and improving the quality of human talent. During the past several decades, the nurture and improvement of human talent has always regulated the operation and development of scientific and technical work at institutions of higher learning. Third, the formation and development of science and technology in the nation's institutions of higher education has had catching up with and surpassing western nations as its goal from the very beginning, taking high quality, precision, and advanced levels as its point of departure. Furthermore, for a long time, a policy of "emphasis on basics and emphasis on improvement" have been followed. Consequently, historically, this system has been a special, closed scientific research operating system distinct from all other scientific research systems that institutions of higher education have fashioned themselves. Fourth, after the state instituted a system for evaluating position qualifications, academic attainments and research results became the main basis for the promotion of professors in institutions of higher education, and it also became an important criterion for judging the value of labor on scientific research. Thanks to the limiting role of the benefits mechanism, promotions in grade and promotions in position became the basic driving force for science and technology in institutions of higher education. Therefore, in the science and technology operating process in institutions of higher education, basic research work related to academic level acquired an automatic, sequential, and incremental inherent driving force. This driving force caused scientific and technical personnel of all kinds and at all levels to take the initiative in overcoming difficulties to create conditions for the sustained and consistent development of research work. Fifth scientific and technical work in the nation's institutions of higher education is extremely uneven. This shows up not only in school quality—major universities and ordinary universities carrying a different research load—but it also shows up in schools management systems—universities under central government jurisdiction and

universities under local government jurisdiction differing in conditions for support for scientific research. Since the advent of reform and opening to the outside world, a further widening of the quality gap between one university and another has occurred as a result of ideas about optimization of the microenvironment and differential development. A splintering of schools' scientific and technical strength has occurred, thereby adding to the imbalance in the scientific and technical work of institutions of higher education. As was said above, the science and technology operating mechanism is a form that manifested itself in a specific social historical process, and a process resulting from the interplay of all factors in the social environment in which it is located. Thus, the science and technology mechanism in institutions of higher education will possess different features at various levels according to its unbalanced nature.

3. Problems Existing in the Science and Technology System of Institutions of Higher Education

Since the advent of reform of the science and technology system, the science and technology work of institutions of higher education has been facing the task of changing paths. This process of changing paths is actually a gestation process of transformation and rebirth of the old mechanism, and growth of a new mechanism. Just what problems exist in the implementation of higher education science and technology operating system during this period of change?

(1) The growth of science and technology operating system in institutions of higher education is not founded on the building of a socialist economy. This is a problem inherited from history, and it is also the source of various problems faced in the science and technology operating system of institutions of higher education. Formerly, institutions of higher education served as an independent scientific research system divorced and separated from the building of the economy. From their research expenses and work conditions to the assignment of personnel, they were completely under state control, depended on handouts from the government, and ate out of a large common pot. Reform of the science and technology system demolished this closed research system, changed the funds allocation system, and introduced the competition mechanism. Thus, the scientific and technical work of institutions of higher education was placed within the overall system for the building of socialism. This exposed the shortcoming of insufficient vitality in the dynamic mechanism for science and technology in institutions of higher education. In recent years, schools and departments in charge of education have devoted very great effort to the building of scientific and technical operating mechanisms in institutions of higher education. Many schools have gone smoothly through the process of changing paths. Nevertheless, the operating expense system, and the dual task system that requires both teaching and research in institutions of higher education still impairs a sense of urgency about deriving motivation from economic construction in institutions of higher education science and technology, and it also impairs the interest of scientific and technical personnel in institutions of higher education in taking part in social competition. This shows up in an overall way in extremely serious cumulative waste despite the large amount of human talent in institutions of higher education, and in day-to-day activities in scientific research being vastly inferior to those conducted in research institutions in society as a whole.

(2) No effective coordination mechanism has been established between the scientific and technical work of institutions of higher education and the building of a socialist economy. This results from both historical and actual reasons, and from inherent and objective reasons. Historically, as was said above, the scientific and technical work of institutions of higher education has been divorced and separated from the economy in its formation. Looked at internally, the scientific and technical workers in institutions of higher education are professors at the same time, although the vocation of professors is to teach people. Thus, they must constantly improve their own academic qualifications and improve their teaching quality. This system requires a natural association between scientific research and teaching, even though various conflicts occur between the two (largely in concrete planning). In the mechanism, however, the two are inseparable. The education function in scientific research in institutions of higher education possesses an inherent self-adapting regulation and control mechanism that is able to combine with education automatically. However, such an automatic regulation and control system is lacking for combining research in institutions of higher education with the social economy. In recent years, both the state and sectors concerned have drawn up all sorts to policy measures to promote the combining of the two. However, due to system limitations, no such coordination methods is on a sound footing as yet. Survey statistics for 1990 showed a 1,225 item (25 percent) increase in institution of higher education-authenticated technology results over 1985, but transfers of technological results from institutions of higher education to business firms declined by 1,863 items (down 27 percent).

(3) Institution of higher education science and technology work lacks a regulation and control mechanism for optimizing the internal structure. Since reform of the science and technology system, very great advances have been made overall in the science and technology work of institutions of higher education, but the pace of advance has differed greatly. Following introduction of the competition mechanism into science and technology work, some schools having a good foundation and abundant resources reacted with alacrity, very quickly adjusting to the changes in the external environment to make new advances on the new operating path. However, for those lacking resources, particularly those whose science departments did a substantial amount of basic research, because of their lack of an internal optimization mechanism that could "make the most of advantages to promote contacts," plus the schools' own lack of operating funds and the lack of effective regulation and

control methods, they appeared weak and passive in the face of an external environment containing a thicket of competitors. In recent years, certain policies related to the evaluation of qualifications for positions have further steered scientific and technical personnel in the direction of dispersal and the setting up of their own units to do research on pure science and small topics. As a result, some schools that were little able to adapt to begin with have gone further into a vicious cycle. Because they lack a regulation and control mechanism to optimize their internal structure, a situation has come about in the scientific and technical research of some institutions of higher education in which goals in the selection of topics are amorphous or duplicative, the subjects become smaller and smaller, and the personnel mix is irrational.

(4) A multifaceted policy guidance mechanism has yet to be established for scientific and technical work in institutions of higher education. The training of high level specialists and the development of science, technology, and culture are the two basic tasks of institutions of higher education, and they are also basic responsibilities of all scientific and technical personnel in the educational system. In order to differentiate their ability to perform these two basic tasks, institutions of higher education have instituted attendant systems of testing and evaluation. Historically, this system, and the policy of "emphasis on basics, and emphasis on improvement," has effectively impelled scientific and technical personnel in institutions of higher education toward basic research. However, following reform of the science and technology system, the functions of scientific and technical work in institutions of higher education expanded. Making fullest use of the scientific and technical work function of institutions of higher education requires a complementary and multifaceted guidance mechanism that includes redirection of research, a change in work orientation, and the promotion, application, and spread of the fruits of research. Although numerous policy measures have been drawn up from the central government to the local government level, because of institutional problems, these policy measures have yet to play a strong guiding role.

(5) A stimulus mechanism attendant upon reform and opening to the outside world has yet to be introduced into scientific and technical work at institutions of higher education. Work on scientific research is work of a high order. The stimulus to work on science and technology comes mostly from the spirit. Social recognition for the fruits of creative scientific research and the role they play in social progress is the greatest inspiration for researchers. It is a basic goal that scientific researchers pursue; it is also what they rely on spiritually for their unflagging conduct of creative work. Since the advent of reform and opening to the outside world, all realms of society have instituted bonus systems based on contribution as a means of stimulating the enthusiasm of those engaged in scientific and technical work. Both the state, various agencies, and local governments have established a multi-level reward system. However, in institutions of higher education, the science and technology reward system is not on a sound footing, and the role it plays is not marked. First is the imbalance of this system in schools by comparison with teaching work. A bonus system is in effect for overtime teaching, and in some schools having the economic wherewithal or in the academy system in schools, compensation for basic work is also figured by the hour. For scientific research work, however, not only is there no remuneration for overtime work, but quite a few units do not take account of the volume of work performed. As for the reward system that the state has instituted for the fruits of scientific and technical research, the effect on most institutions of higher education has not been marked. First, not many rewards are issued. Take 1990, for example, when more than 1,000 institutions of higher education nationwide received a total of 204 national level achievement awards. In terms of the total number of people engaged in research in institutions of higher education, the probability of getting a reward was 18 in 10,000, which is to say that the opportunity for obtaining an award was only approximately 1 for every 2,000 research and development personnel. Many people could only "look at rewards and sigh." Second, the types of reward are too few; they do not cover a wide enough field. They do not include all the creative labor that goes into scientific and technical activities. Thus, they do not help fully arouse the zeal of personnel engaged in experiments, management, library information, and logistical support for scientific research. Third, the amount of material rewards is not high. The amount of reward money that individual scientific and technical personnel receive is insignificant in comparison with the value of the number of years, or even the number of decades they have labored. Fourth, the prestige value of scientific and technical awards is not high in China. The prestige value of scientific research rewards contrasts greatly with other kinds of rewards.

4. The Building of a Complete Operating Mechanism Is a Fundamental Task in Reform of Institutions of Higher Education

Since the advent of reform and opening to the outside world, as an accompaniment to complete reform of the social system, institutions of higher education have carried out a series of reforms as their own circumstances have permitted in carrying out CPC Central Committee decisions on reform of the science and technology system. They have readjusted the percentages of the three kinds of research and straightened out the research management system; they have made the most of multiple advantages for the building of research organizations or research centers that cut across academic fields; they have oriented themselves toward economic construction, setting up in conjunction with production units a partnership system that encompasses teaching research, and production; they have taken part with scientific and technical enterprise and science parks

in the development of high technology and industrialization work; they have introduced the competition mechanism, setting up all sorts of testing and bonus systems; they have intensified management by objective expanding the decision-making authority of grassroots level scientific research units, etc. As a result of these reforms, the whole face of scientific and technical work has undergone fundamental change. In order to meet new state requirements for scientific and technical work in institutions of higher education, they have further put to use the potential energy of scientific and technical work in institutions of higher education for an improvement in results from scientific research. In the future, they will further intensify reform, the goal of this reform being to build a complete scientific and technical operating mechanism.

The structure of the institutions of higher education science and technology operating system is to be determined by the basic function that the scientific and technical work performs. The basic tasks of scientific and technical work that institutions of higher education develop are promotion of socio-economic development, raising science and technology standards, and improving the quality of higher education. This is to say that science and technology work in institutions of higher education faces three main tasks as follows: First is to take the initiative in meeting the needs of socialist modernization, advancing socio-economic development; second is to raise standards in science and technology, developing a modern knowledge industry; and third is the training of high level specialists, developing higher education. A science and technology operating mechanism that accomplished these three tasks must have a complete and optimum internal structure; it must possess a harmonious and coordinated external environment; and it must possess an internally functional operating system that is automatic, sequential, incremental, and filled with vitality in all of its research, development, promotion, and application links. Such a system is composed of the following main structures:

(1) A sustained and consistent power mechanism. This is a crucial link for the maintenance of internal vitality in scientific and technical work. A power mechanism is shaped by objective social requirements, and is limited by the benefits of scientific and technical personnel. What is meant by benefits in this context is in both ideological and material form. Likewise, the method of stimulation and the content also includes an ideological and a material form.

(2) A self-adjusting internal structural optimization mechanism. This is an important link for ensuring overall efficiency in the scientific and technical work of institutions of higher education. The crafting of a optimizing mechanism cannot be done without a competition mechanism, and it is limited by the management system and policy guidance. An optimized content includes the orientation of research, the composition of the research topics, the organization of personnel, the allocation of expenses, the use of facilities, etc. An optimized structure is a piece of systems engineering that must rely for its realization on overall regulation and control through competition, economic levers, policy guidance, and scientific management. Furthermore, among the various internal structure factors, the human factor is the key; therefore, improvement of the ideological and political quality of scientific and technical personnel, and promotion of a spirit of dedication to science and strong scientific ethic is of crucial importance.

(3) A coordination mechanism that is in keeping with the building of the economy. This is an indispensable link for ensuring that science and technology in institutions of higher education perform a social function, and it is also the bond that ties the institution of higher education science and technology operating mechanism to social production as a whole and the economic development mechanism. Multifaceted policy orientation and effective stimulation measures play a fine role in improving its operation, but the key limiting factor is institutional problems. The integration of the economic system with the science and technology system is a basic task in reform.

Institution of higher education scientific and technical work is done within the context of the educational system where it is subject to the limitations of the many factors that spur the development of education and the economy and improve scientific and technical standards. It is a structurally complex system. A protracted process of reform is required to produce growth, development and perfection of a fine operating system, as well as supersession and replacement. We must adhere to the Party's basic line, gradually restructuring the science and technology system in institutions of higher education in a spirit of reform of the science and technology system so that it meets needs the requirements of socialist modernization.

Electronics Industry Eighth 5-Year Plan Key Tasks Set

92FE0503I Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese 25 Mar 2 p 1

[Article by Correspondent Liu Jiuru [0491 0046 1172] and Reporter Yang Zhihe [2799 0037 0735]: "China's Electronics Industry Sets Key Eighth 5-Year Plan Tasks. Firm Attention to Advances to a New Stage in the '438'"]

[Text] The key tasks of China's electronics industry during the Eighth 5-Year Plan are firm attention to the "438," meaning close attention to the four major construction projects, carrying out the three special technological transformation projects, and making breakthroughs in and mastering the eight key technologies. This was spelled out in *Ten Year Plan and Eighth 5-Year Plan for China's Electronics Industry,* which the Ministry of Machine Building and Electronics recently drew up.

The so-called four major projects are the integrated circuit project, the computer and software project, the communications project, and the military electronics project. The three special projects are the use of electronics for the technological transformation of traditional industries, the digestion, assimilation, and sinicization of imported technology, and the new model component parts project. The eight key technologies are the design of VLSI circuits and the industrialization of production technology, development of fourth generation computers and the industrialization of production technology, systems software engineering technology, mobile communications and fiber optic communications, ISDN technology, digitalization of video and audio products and HDTV technology, SMT [surface mount technology] and associated technology, optoelectronic and sensor technology, and military electronics technology.

According to a briefing, in order to fulfill the key "438" expeditiously, the Ministry of Machine Building and Electronics has drawn up a development plan in which science and technology plays the leading role, quality is the main line, and which adheres to self-reliance and greater international cooperation. It emphasizes making service the aim and making demand the goal for breakthroughs on key points, overcoming duplication and dispersal, and concentrating forces to conduct "base style" building in an effort to produce the economies of scale.

It is estimated that once the Eighth 5-Year Plan tasks have been expeditiously fulfilled, the technology and scale of production of China's electronics industry will advance to a new stage.

Joint Nuclear Laboratory Set

40101018D Beijing CHINA DAILY (National) in English 15 May 92 p 3

[Article: "Joint Nuclear Lab Set"]

[Text] Harbin (Xinhua)—A nuclear analysis laboratory jointly founded by Russia and Northeast China's Heilongjiang Province has recently gone into operation, according to provincial government sources.

Most of the analysis equipment is provided by the Russian side, while the computer system is from the Chinese partner. So far, all the equipment has been functioning well.

According to the sources, the investment in the lab totalled $140,000, with $90,000 from the Chinese side and the rest from the Russian partner.

The lab was established in accordance with an agreement between the two sides signed in December of 1990.

According to the agreement, the lab will supply Chinese firms with nuclear analysis apparatus that is widely used in the mining, metallurgy, coal, petroleum and other industries.

Wideranging Financial Reform of High-Tech Development Zones

92FE0503H Beijing GUANGMING RIBAO in Chinese 17 Mar 92 p 1

[Article by Correspondent Liu Jingzhi [0491 2417 2535]: "State Science and Technology Commission System Reform Department Official in Charge Provides Briefing on Five Ideas for Courageous Exploration of Comprehensive Reform of High- and New-Technology Industry Development Zones. Includes Reform of Enterprise Equity Relationships, Distribution System, and Investment System"]

[Text] It has recently been learned from the System Reform Department of the State Science and Technology Commission that new strides are to be made in comprehensive reform of the nation's high- and new-technology industrial development zones. A person in charge provided a briefing on five ideas for reform of the development zones.

Reform of Enterprises' Equity Relationships. The straightening out of enterprises' assets relationships and their responsibility, authority, and interests relationships, and the delineation of enterprises' assets will serve as a basis for trial operation of a share system, with the institution of enterprise organizational forms including partnership enterprises, cooperative enterprises, limited liability corporations, and joint-stock limited corporations. Stock participation among juridical persons will be encouraged, the issuance of shares for intellectual property rights will be permitted, staff members and workers may be guided in a planned way in the holding of shares, and foreign capital shareholding will be actively attracted. Transfer and circulation of shares will be permitted through over-the-counter trading. The transfer of equity rights for compensation and an enterprise bankruptcy system will be promoted, mergers, contracting, leasing, and auctions used to promote the rational flow and optimum organization of the elements of production. A new economic relationship will be gradually built between one enterprise and another, and between enterprises and their staff members and workers.

Reform of Enterprises' Distribution System. Institution of proportional control to link enterprises' total wage bill to enterprises' returns for the complete smashing of the situation in which "enterprises eat in common out of a large national pot, and staff members and workers eat in common out of a large enterprise pot." This proportional control will be premised on ensuring that the increase in enterprises' accumulations is greater than the increase in its consumption, and that the rise in the labor productivity rate is greater than the rise in the total wage bill.

Enterprises will themselves determine the internal distribution system and reward and punishment methods on the basis of the principle of distribution according to labor for a full stirring of the interest of scientific and technical personnel, administrators, and the rank and file. In this way, individuals who make outstanding contributions will be legally able to obtain corresponding remuneration.

Good Performance in Dovetailing Plan Control With Market Regulation. It is necessary to make full use of the role of market regulation to stimulate enterprises to build their own new type operating mechanisms for raising capital, for voluntary organization, autonomy in operation, responsibility for their own profits and losses, self-development, and self-limitation. The guiding role of industrial policy, technology policy, and plan regulation and control must be brought into play to guide development zones in the development of leading industries in accordance with national policy and local characteristics.

Building a Social Security System and a Socialized Support Service System. This includes trial use of methods whereby the state, enterprises, and individuals themselves bear, and whereby society as a whole solves the problem of unemployment, retirement, and medical treatment insurance costs. Existing financial institutions are to be used to develop enterprise and individual home savings and loan activities. The building of support services institutions for information, consulting, agent, and broker services, and accounting is to be accelerated to ensure that high-technology enterprises concentrate their strength on developing and producing high technology and high technology products.

Reform of the Investment System, Building a Multi-Channel, Multiform Social Financing System. The state and local governments should use counterpart investment guidance funds to encourage development zones and enterprises to use various means of raising capital. They should permit enterprises to issue stocks and bonds to raise funds in society and to actively attract the investment of foreign capital. Development zones having requisite conditions should try out the founding of risk investment funds and risk investment mechanisms.

More Funds To Aid Technology Renovation

40101018B Beijing CHINA DAILY in English 21 May 92 p 1

[Article: "More Funds To Aid Tech Renovation"]

[Text] In a major boost to the country's drive toward industrial renovation, the People's Construction Bank of China is set to offer 400 million yuan (about $74.1 million) in loans this year to support proposed science projects.

The bank is currently engaged in assessing 174 candidate projects in science and technology, recommended by the State Science and Technology Commission, to determine whether these projects are worth financial backing, according to yesterday's overseas edition to PEOPLE'S DAILY.

The People's Construction Bank of China began making the loan offers in 1990, and has so far granted a total of 500 million yuan ($92.6 million) in loans to 270-odd national-level science and technology development undertakings.

According to the report, the loans will mainly flow into those national key projects on research and development of new products, technology and materials.

They will also be given to undertakings which need imports of technological software and other equipment to help the national drive to introduce more advanced foreign scientific and technological achievements.

The bank's move is part of an overall effort by the central and local governments recently to bolster China's development of science and technology.

The central government has pledged more financial assistance to boost science and technology in coming years, seeing it as vital to the improvement of economic efficiency of State-run enterprises.

According to Vice-Minister Li Xu'e of the State Science and Technology Commission, China's funding for research and development will increase to about 1.5 percent of the Gross National Product (GNP)—close to the standard of medium-developed nations—double the current ratio of only 0.72 percent of the GNP.

The government will try to pour more than 10 billion yuan of special loans ($1.85 billion) into the development of science and technology annually around the end of the Eighth 5-Year Plan period (1991-95). Currently the loan figure stands at 6 billion yuan ($1.1 billion).

In addition, the central government has urged local governments and enterprises to raise development funds through any possible channels.—(CD News)

Scientific Research Needs More Funding

40101018E Beijing CHINA DAILY (Opinion) in English 5 May 92 p 4

[Article: "Scientific Research Needs More Funding"]

[Text] A new investment system is badly needed to accompany the reforms in China's fields of science and technology.

An article in the Beijing-based newspaper SCIENCE AND TECHNOLOGY DAILY says the introduction of reform into science and technology in recent years has slashed the hope of scientific and technological institutions for financial allocations solely from the government. Now they have to rack their brains to find ways to fund their research programmes.

Many science and technology institutions nationwide have felt the shift form receiving free government support to having to seek funding from other sources.

According to the article by Ma Xiguan of the State Commission of Science and Technology, these sources include the government, which still provides funds gratis, financial agencies that allocate loans, and scientific and technological institutions that raise money by scientific and technological development.

The adjustment has mobilized a competitive spirit in science and technology and strengthened personnel awareness of the need to turn laboratory research results into finished products.

But China's total investment in science and technology cannot meet the demand for scientific and technological development.

The crux of absorbing funds from various channels lies in speeding up the popularization of laboratory results.

The article calls for more investment in this phase, during which laboratory research results are put into production. Most scientific and technological achievements are pigeonholed in China: only 10 percent of the nation's annual 10,000 patents are put into mass production.

It is imperative to establish a new investment system for science and technology, the article recommends, to take in funds from various channels. It is impossible to depend merely on the government for science and technology budgets.

Chinese enterprises should be encouraged to play a larger role in investing in scientific and technological research and development.

But they still begrudge allocating funds for research and development (R&D). In 1990, for example, the financial input in R&D from enterprises stood at 9.05 billion yuan ($1.7 billion), making up 30 percent of China's total investment in science and technology.

A new investment system for science and technology would ensure some stable channels for funding.

The article suggests the establishment of investment companies in China to issue science and technology bonds and shares to absorb money from home and abroad.

Scientific and technological activities include basic R&D, transfer and application of research achievements, and paid scientific and technological services.

The article analyzes the characteristics of the three aspects and suggested appropriate investors for them.

The results of basic research may be reports, or theses, or data, or samples, which are unlikely to make profits directly. The financial input at this stage should be free aid from the central government and enterprises, and domestic and overseas donations.

The second stage is the essential step to turning laboratory results into finished products to make profits. However, there is also some risk of failure. Therefore, according to the article, the investment in this phase should be composed of allocations from the central government and loans from financial institutions and investment companies.

Scientific and technological services support and provide information for the public interest. The funds for this part should be included in the government's science and technology budget. Research institutions should also raise money by themselves.

Shenyang Pioneers Greater Funding of Science and Technology

92FE0503k Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 13 Apr 92 p 3

[Article by Shenyang Municipal Science Commission: "Maintain the Link Between Science and Technology and Finance and Banking To Build a New Kind of Science and Technology Investment System"]

[Text] The serious shortage of money to invest in science and technology has been a major stumbling block in the development of scientific and technical undertakings. In the process of reforming the science and technology system, Shenyang City has boldly tried out linking science and technology to finance, gradually making the link-up of science and technology to finance and banking more scientific, systematized, and regularized, thereby open new channels for increasing investment in science and technology.

In 1985, Shenyang City was the first to pioneer loans for science and technology, thereby taking the first step in linking science and technology to finance and banking. In 1987, the Shenyang Branch of the Chinese Industrial and Commercial Bank formally opened a science and technology credit department in the laying of an important foundation for linking science and technology to finance and banking. In February 1989, the municipal science committee assembled leaders of scientific research units, institutions of higher education, and six banks in the financial world for a dialogue that advanced further association between the scientific and technical world and the financial world. In that year, 56.7 million yuan worth of loans were issued for science and technology. These loans very quickly reaped marked returns, which greatly stirred the interest of both scientific research units and the banks. During 1990 and 1991, Shenyang city's loans for science and technology increased to 150 million and 340 million yuan respectively. In 1992, Shenyang further increased its investment in science and technology, loans outstanding totaling 600 million yuan in the provision of powerful financial support for the development of science and technology.

High investment created high returns. In 1991, 328 projects held Shenyang City loans for science and technology, 124 of which have been completed for the realization of 805 million yuan in output value and 140 million yuan in profits and taxes. This was a 1 to 6 input-output ratio, a ratio much greater than the 1 to 1 input-output ratio realized from investment in fixed assets. The series of new technology projects including bank machines, digitally controlled machine tools, oil-submersible motors [3383 3111 7193 2623], and biological pharmaceuticals have already produced more than 10 million yuan in returns. It is estimated that once the production from these projects is up to full speed, an output value of 1.87 billion yuan, and taxes and profits of 370 million yuan will be realized. Shenyang used the following ways to link science and technology to finance and banking:

1. Making up special loans for key science and technology projects to ensure smooth execution of state torch plans, key science and technology problem plans, new product test manufacture plans, spark plans, and plans for the promotion of achievements gained in research. In 1991 alone, 200 million yuan in loans was issued for Torch Plan projects, which yielded an output value of 494 million yuan and 81.96 million yuan in profits and taxes. Loans for Spark Plans totaled 46.9 million yuan, which increased income by 280 million yuan.

2. Providing working capital loans for science and technology, and providing revolving credit for certain research units in a break with the former situation in which research units never had any working capital credit provided, thereby solving the nagging worries of research units. For the past 4 years, Shenyang City has issued 210 million yuan in working capital loans. In 1991, Shenyang approved 17.78 million yuan in fixed working capital loans for 10 research units including the Cybernetics Institute. It supported the living and operating activities of a total of 70 scientific research units, which realized a cumulative output value of 320 million yuan and 80 million yuan in profits and taxes.

3. Short-term finance bonds for science and technology were issued, the municipal science committee organizing the work, with bond companies acting as agents in issuing the bonds. The People's Bank centrally examined and approved the working capital short-term finance bonds, the time limit and interest being set in accordance with the People's Bank procedures for the issuance of short-term finance debentures. In 1989 and 1990, a total of 10 million was issued, much to the delight of scientific research units. During 1992, Shenyang will issue a number of 3 to 5 year bonds totalling 50 million yuan to high-technology enterprises.

4. For the building of a science and technology development risk fund, a total of 20 million yuan was raised through various channels including tax reductions or exemptions for the three expenses (intermediate trial expenses, new product trial manufacture expenses, and major scientific research project supplementary expenses), and new products. These funds will be used mostly for risks attending the construction of intermediate test bases.

5. Running a science and technology insurance system, adding a new kind of risk to the coverage that insurance companies provide. Enterprises or scientific research units may apply to insurance companies for insurance on fixed assets such as their scientific research instruments and equipment, or insurance companies may provide insurance for the results of new technology and patented technology that is transferred.

6. Leasing of materials including the leasing of imported equipment and leasing of high-technology products.

7. Issuance of share certificates within enterprises. This is to be tried out first in high technology research academies and high-technology enterprises as a means of rasing funds for internal projects following the principle of voluntary participation, mutual benefit, and payment of compensation. In addition, the intermingling of enterprise funds and bank funds is to be explored.

8. Operation of trusts for science and technology in the pioneering of new channels for funding science and technology, including investment in science and technology, the building of science and technology storehouses, and transfers of capital.

9. Leasing of scientific achievements, setting up science and technology achievements banks.

Shenyang has built a science and technology funds support system in which large amounts of capital form the fuselage and government disbursements, and self-raised money form the two wings. This has become a powerful force in impelling science and technology into the economy.

Shenyang's main experiences in promoting the link-up of science and technology with finance and banking have been as follows:

1. Serious Attention on the Part of Leaders and Effective Actions. The Shenyang Municipal CPC Committee and municipal government have elevated the linking of science and technology to finance and banking to a strategy for advancing the coordinated development of science and technology, the economy, and society. Principal leaders have several times noted the need for the finance and banking world to "increase the tilt in the direction of science and technology," adhering to the attainment of "three unswervings," namely unswerving link up with science and technology, unswerving tilt in the direction of science and technology, and unswerving attention to organization, coordination and funding of the development of science and technology. In February of each year since 1987, the finance and banking world has held a meeting to discuss the linking of finance to science and technology, which principal leaders from the CPC municipal committee and city government attend. Shenyang City has also set up a leadership team for the

linking of finance to science and technology in which municipal science committee and People's Bank leaders serve as the team leader to decide on important matters in the linking of science and technology to finance. The municipal CPC committee standing committee, together with finance and banking units and economic units, visit grassroots units where they handle official business on the spot for the timely solution of problems that scientific research units and enterprises encounter such as the shortage of funds for science and technology.

2. Scientific Assessments To Choose Preferred Projects. In order for science and technology loans projects to be approved as soon as possible and put into effect in a timely fashion, and to ensure that loan funds are effectively invested, the municipal science committee cooperates closely with the bank, the two working together in organizing project management from starting the project to evaluating it, validating it, and examining it. The science committee, the bank, and the unit in charge hold joint hearings. In these hearings, the banks focus on economic matters, examining the project's funding channels, raw and processed materials costs, markets, and economic returns. The science committee focuses on the industrial structure and project technology to ensure the project success rate. Shenyang City has also set up a science and technology financial assessment committee for better management of institutions that assess the economics of science and technology as a means of reducing and avoiding policy mistakes. Since its founding, the committee has assessed more than 1,200 projects having a total investment of more than 30 billion yuan, turning down more than 200 projects, thereby saving the state several hundred million yuan.

3. Level-by-Level Interaction; Cooperation Geared to the Job. Mindful of work needs, the Shenyang Municipal Science Committee and the banking sector set up stable and harmonious channels for association and cooperative relationships to accomplish the task of linking finance to science and technology, making sure that there is continuity, no omissions, and no obstacles from the decision-making level to the implementation level. Interaction takes place at all times between the director of the science committee and the bank manager, between the science and technology department director and the bank director, and between working personnel in the science committee and credit personnel, all of whom are thoroughly familiar with the work to give impetus to the development of a pervasive link-up between finance and science and technology.

Practice during the past several years shows that the way in which Shenyang City has linked science and technology to finance has played a major role in the development of science and technology and the invigoration of the economy. In order to give further impetus to the development of this work, Shenyang City intends to exercise greater leadership in setting up a funds support system that has more channels and a more complete risk mechanism for the development of science and technology, do a good job of running scientific research unit and high-technology enterprise share system pilot projects, improve basic regulations for linking science and technology to finance and theoretical study of the operating system, and adopt a policy of strong rewards and severe punishment for the work of linking science and technology to finance to give genuine impetus to healthy development of the link-up of science and technology to finance.

Meeting on Secrets Protection

40101018C Beijing CHINA DAILY (National) in English 15 May 92 p 3

[Article: "Meeting on Secrets Protection"]

[Text] (Xinhua)—A three-day national conference on protecting State secrets ended in Beijing on Wednesday.

Speaking at the conference, which opened on Monday, Qiao Shi, a member of the Standing Committee of the Political Bureau of the Central Committee of the Communist Party of China, said that China faces an arduous task in protecting Party and State secrets.

Qiao, who is also in charge of the Party's Secrets Protection Committee, revealed that leaks of State and Party secrets are far from rare, and are in some cases rather serious. He said that such leaks have caused great harm to the interests of the country and people.

The protection of Party and State secrets should also serve efforts for reform, opening to the outside world and economic development, said Qiao, adding that secrets which should be declassified must be declassified.

He urged Party committees and governments at all levels to strengthen efforts to protect Party and State secrets.

Foreign Talent Sought

40101018F Beijing CHINA DAILY (SHANGHAI FOCUS) in English 19-25 Apr 92 p 1

[Article by Chen Qide and Cai Zhiqiang: "Foreign Talent Sought"]

[Text] Shanghai is mounting a campaign to introduce more foreign talent into the city to ensure rapid economic development.

It is expected more than 1,000 foreign experts will come to work in the city in the next few years.

As the development of the Pudong New Area speeds up, Shanghai will need to call for more foreign experts and technicians, "but it is hard for the city to find sufficient talent from abroad," said Qu Ding, director of the International Exchange and Co-operation Department under the Shanghai Municipal Personnel Bureau.

"We don't know where to get our experts because of a lack of information," the director said.

As a result, the city has only been able to fill 68 out of 138 requests for foreign talent this year.

To help solve the problem, an international seminar was held on April 17. Participants from the United States, Japan, Britain, France, Germany, Singapore and Canada as well as diplomats and foreign managers from local consulates and foreign-funded ventures discussed ways to attract more foreign talent.

"The seminar's purpose was to let foreigners know more about Shanghai so that they can pass the information on to their compatriots," said Qu.

In the past four years, the city has introduced 520 experts and scholars from more than 20 countries, such as the United States, Germany, France, Britain, Italy, Japan and Canada, who specialized in machinery, light industry, chemistry, medicine, agriculture and education.

According to the director, the foreigners attending the seminar discussed co-operation in tourism, robotics, cosmetics, commerce, insurance, fishing and instrumentation.

He said the efforts were being made to spur the development of the Pudong New Area and vitalize the local large and medium-sized State-owned enterprises.

The director disclosed that the city is planning to set up liaison offices in Germany and Japan this year as bridges for foreign experts and technicians who are willing to come to work in Shanghai.

And also, he said, two training bases will be established in the United States and Hong Kong for about 800 directors and managers from local large and medium-sized State-run enterprises so they can learn more overseas advanced management there.

Apart from this, 10 delegations will be sent as well to the United States, Japan, Singapore, France and Hong Kong this year for exchanges in finance, insurance, tourism and administration management.

Qu said in the next few years the city will focus its introduction of foreign talent on experts and technicians specializing in urban construction, machinery, aviation and space flight, biotechnology, textiles, light industry, petrochemicals, commercial management, agriculture, telecommunications and computers.

Furthermore, the city will increase co-operation with Britain, Italy, Canada, Australia and Malaysia in talent exchanges.

Phase-Locked Loop Speed Control for Remote Sensor

92FE0443B Beijing ZHONGGUO KONGJIAN KEXUE JISHU [CHINESE SPACE SCIENCE AND TECHNOLOGY] in Chinese Vol 12 No 1, Feb 92 pp 50-56

[Article by Zhu Min [2612 2404] of the Beijing Institute of Electromechanical Research and Design: "Phase-Locked Speed Control for a Remote Sensor"; MS received 20 Feb 91]

[Text] **Abstract**

The two basic requirements for space remote sensors are: adequate Earth coverage and high resolution. Resolution is an important measure of performance in a remote sensor. Because the satellite motion introduces distortions in ground images, accurate motion compensation of the image must be performed to improve resolution. In this article, the design of a phase-locked loop (PLL) with fast response, low power consumption, good anti-jamming capability and high accuracy (0.1 percent) is presented. This design can meet the remote-sensor requirement of 5-m ground resolution.

1. Introduction

To obtain the image of a large-area ground target requires the synthesis of many single images. In practice, a remote sensor can be installed on a satellite to cover the ground target by taking continuous pictures. However, because of the orbiting motion of the satellite and the movement of the camera during the imaging process, distortions are introduced on the film, producing fuzzy pictures. In order to improve the picture resolution, it is necessary to apply motion compensation to the image; an effective way to achieve accurate image compensation is to use phase-locked techniques.

2. System Performance Measure and PLL

2.1 Image Compensation

Because of the orbit motion of the satellite and the onboard remote sensor, relative motion exists between the image taken by the sensor and the film, producing an image drift δ:

$$\delta = V_I \cdot \tau \qquad (1)$$

where V_I is the image drift speed; τ is the time of exposure.

$$V_I = \frac{V \cdot f}{H} \cdot \cos\varphi \qquad (2)$$

where V is the satellite velocity; H is the satellite height; f is the focal length of the camera; and φ is the scan angle of the camera.

In order to compensate for the image drift caused by satellite motion, the image compensation system must provide a compensation velocity V_c such that (vector) V_c = - (vector) V_I.

For a remote sensor whose focal length is 1 m, and whose velocity and altitude are 7.8 km/s and 200 km respectively, the maximum image drift speed is

$$V_{I\max} = \frac{V \cdot f}{H} = \frac{7.8 \times 1000}{200} = 39(\mathrm{mm/s}), \qquad (3)$$

When the dynamic resolution of the remote sensor is 100 lines/mm and the time of exposure is 1/200 s, then the compensated image drift should be smaller than the reciprocal of twice the resolution,[4], i.e.,

$$\Delta\delta < \frac{1}{2 \times 100} = 0.005(\mathrm{mm}) \qquad (4)$$

If Δδ = 0.002 mm, then

$$\left|\frac{V_C - V_I}{V_C}\right| \approx \left|\frac{V_C - V_I}{V_{I\max}}\right| = \frac{\Delta\delta/\tau}{V_{I\max}} \approx 0.01 \qquad (5)$$

Equation (5) indicates that the accuracy of compensation should be around 1 percent. However, since most compensation techniques such as moving optical wedges, optical lenses or stretched plates have inherent errors, and the compensation results are directly affected by the ability to control the time exposure, the compensation system must be able to provide a higher relative accuracy. In practice, the accuracy requirement is around 0.1 percent. Furthermore, in order to satisfy the earth-coverage requirement, the range of the speed-control system should take into account variations in the speed-to-height ratio, which is approximately 1.5.

2.2 PLL

Phase-lock techniques are commonly used to improve system accuracy. A key component of the PLL is the frequency phase detector (FPD), which is a CMOS device, type CD4046. It is capable of not only phase detection but also frequency detection; its phase detection region is linear within the range +/- π. Another feature of the CD4046 is that its locking range is equal to the capture range, and is independent of the filter. This feature greatly reduces the calibration time, and facilitates the design and tuning of the correction network. Figure 1 shows a mathematical model of the PLL.

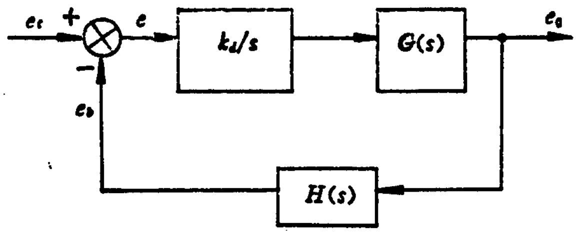

Figure 1. Mathematical Model of the PLL

The transfer function of the phase detector is k_d/s, and the error transfer function is:

$$E(s)=\frac{1}{1+k_d/s\cdot G(s)\cdot H(s)} \qquad (6)$$

The input to the PLL $E_i(s)$ is the frequency-converted sampled output of the speed-to-height ratio of the satellite. The frequency change of $E_i(s)$ can be considered as a step function. The steady-state error of the system is:

$$e_{ss}=\lim_{t\to\infty} e(t)=\lim_{s\to 0}\frac{S\cdot E_i(s)}{1+k_d/s\cdot G(s)\cdot H(s)} \qquad (7)$$

Equation (7) shows that as long as G(s) x H(s) does not contain a pure differential factor s, the steady-state error of the system $e_{ss} = 0$. Theoretically, a PLL used for speed control is a first-order error-free system. In practice, the accuracy of the PLL can be as high as a few parts in 10,000 or a few parts in 100,000, which clearly satisfies the accuracy requirement of image compensation circuits used in remote sensors.

3. Analysis and Design of the Phase-Locked Control System

A block diagram of the phase-locked control system is shown in Figure 2.

3.1 Speed Loop

Figure 3 shows a block diagram of the speed feedback system, where h is the feedback coefficient. From Figure 3, one can derive the equivalent transfer function of the electric motor with speed feedback:

$$\frac{E_0(s)}{E_1(s)}=\frac{\dfrac{k_m}{1+h\cdot k_m}}{\dfrac{T_m}{1+h\cdot k_m}\cdot S+1} \qquad (8)$$

Equation (8) shows that by introducing speed feedback, the equivalent time constant of the motor is reduced by a factor of 1 + h x k_m, i.e., the response time is increased by a factor of 1 + h x k_m. On a Bode plot, the angular frequency is increased by a factor of 1 + h x k_m, which implies that the closed-loop bandwidth of the system will also increase, resulting in faster response time.

The time constant T_m of the electric motor is proportional to the moment of inertia of the load T;[2] because of the large variations in the moment of inertia when the angular frequency induced by the motor time constant approaches the system cut-off frequency, system correction becomes more complicated. Therefore, reducing the motor time constant will improve the closed-loop stability of the system.

Introducing speed feedback can also increase the rigidity of the electric motor. From Figure 4 one can estimate the

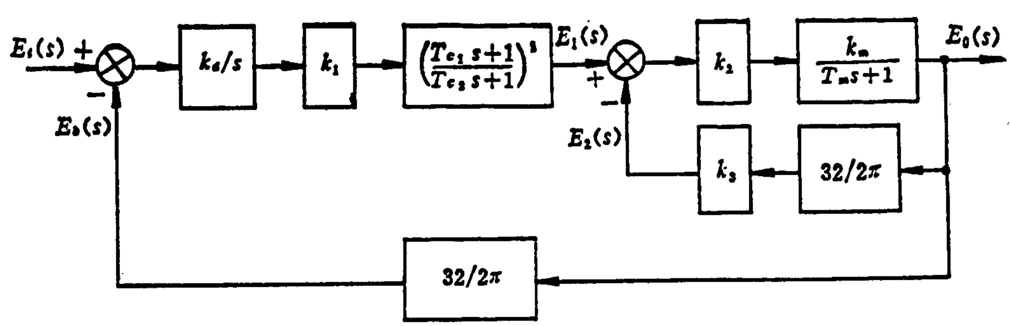

Figure 2. Block Diagram of System Dynamics

Note: k_d—sensitivity of the phase detector (12/2π) V/rad; k_1—primary circuit amplifier with an amplification factor of 5; T_{c1}—time constant of the zero of the correction network, 0.3s; T_{c2}—time constant of the pole of the correction network, 2.1s; k_2—speed loop amplifier with an amplification factor of 10; k_3—frequency voltage conversion factor, -0.0025π V/rad; k_m—gain constant of electric motor, 25 rad/(sV); T_m—time constant of electric motor, 0.3s.

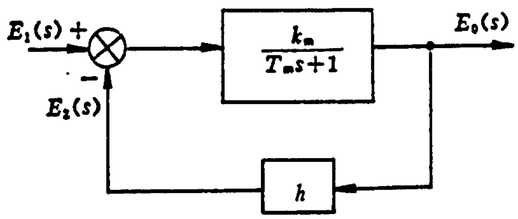

Figure 3. Block Diagram of the Speed Feedback System

effect of disturbances on the electric motor with and without speed feedback.

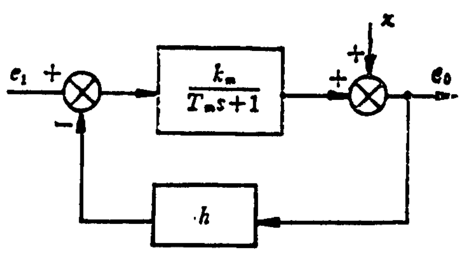

Figure 4. Block Diagram of the Electric Motor System With Disturbances

Without feedback, we have:

$$\Delta e_0 = \Delta x; \qquad (9)$$

the effect of disturbances on the system output is 1:1.

With feedback, we have:

$$\Delta e_0 = \frac{\Delta x}{1+G \cdot h} \cdot \qquad (10)$$

Thus, with speed feedback, the effect of disturbances on the system output is reduced by a factor $1/(1 + G \times h)$.

The CD4098 is a monostable trigger [i.e., multivibrator] device with an edge-triggered input and its output is a fixed-bandwidth pulse. The speed-measuring unit receives a continuous square wave e_0 from the system output axis whose frequency varies with the speed of rotation. Its transfer function is:

$$\frac{E_0'(s)}{E_0(s)} = \frac{32}{2\pi} \cdot S \qquad (11)$$

As the frequency of e'_0 changes, the fixed-bandwidth monostable trigger will generate a continuous pulse whose duty cycle varies with the input frequency. Figure 5 is a practical frequency-voltage conversion circuit designed to implement the speed feedback function. R_1, C_1 can be adjusted to yield $k_3 = -0.0025\pi$ V/rad; R_2, C_2 provide a low-pass filter which has little effect on the system dynamics and therefore can be ignored.

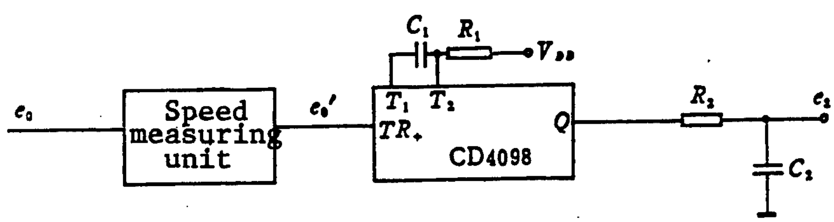

Figure 5. Speed Feedback Circuit

The equivalent transfer function of the electric motor with speed feedback is:

$$\frac{E_0(s)}{E_1(s)} = \frac{\dfrac{k_2 \cdot k_m}{T_m \cdot S+1}}{1+\dfrac{k_2 \cdot k_m \cdot \frac{32}{2\pi} \cdot k_3}{T_m \cdot s+1}} = \frac{\dfrac{k_2 \cdot k_m}{1+\frac{32}{2\pi} \cdot k_2 \cdot k_m \cdot k_3}}{\dfrac{T_m}{1+\frac{32}{2\pi} \cdot k_2 \cdot k_m \cdot k_3} \cdot S+1} \qquad (12)$$

Compared to the case without speed feedback, the time constant is reduced by a factor of

$$\frac{1}{1+\frac{32}{2\pi}\cdot k_2\cdot k_m\cdot k_3}$$

3.2 Correction Network

In order to increase the value of the speed error coefficient and to achieve good relative stability, the gain in the low-frequency band should be sufficiently large; also, on the Bode plot, the slope of the logarithmic amplitude curve near the frequency axis should be equal to -20 dB/+ decade. This slope should be extended over a wide frequency band to ensure that the system has adequate phase margin. In the high-frequency band, the gain should drop off quickly to provide sufficient noise suppression.

Selection of the gain-frequency intersection point should be based on a compromise between the system response time and the suppression of external disturbances and internal noise. For the present system, the cut-off frequency is chosen to be several tens of Hertz.

In order to compress the bandwidth and to provide adequate gain in the low-frequency band, it is necessary to have the gain dropping quickly before the intersection point with the frequency axis. This can be accomplished by introducing a correction network with the proper lag. To ensure that the system has adequate phase margin, it is necessary to provide phase compensation at the frequency-axis intersection point. This can be accomplished by using a correction network with the proper advance. In this system, a correction network with double lag and advance is used; the basic design of this correction network is presented below.

The cut-off frequency without correction network is:

$$\omega_c \approx 210 \qquad (13)$$

and the phase margin is:

$$\varphi_c(\omega_c) = 180^\circ - 90^\circ - tg^{-1}\, 0.027\, \omega_c \approx 10^\circ \qquad (14)$$

The phase margin shown in equation (14) is inadequate. In order to achieve fast system response and to provide effective suppression of circuit noise and external disturbances, the cut-off frequency is chosen to be $\omega_c = 20$, and phase-margin compensation is also used. The transfer function of the correction network is:

$$G_c(s) = \left(\frac{0.3s+1}{2.1s+1}\right)^2 \qquad (15)$$

The circuit diagram of the correction network is shown in Figure 7.

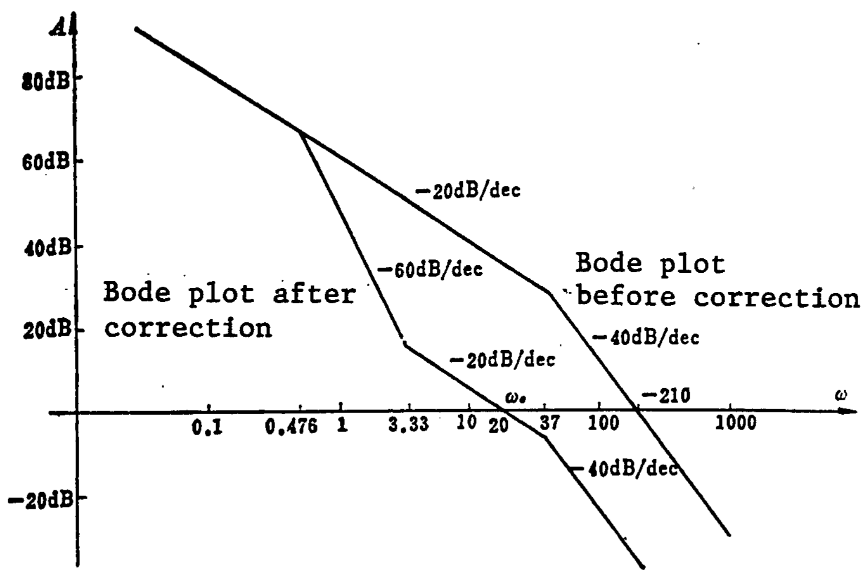

Figure 6. Bode Plot of the System Before and After Correction

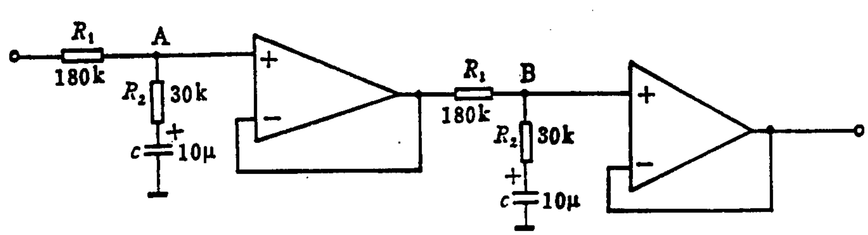

Figure 7. Circuit Diagram of the Correction Network

The open-loop transfer function of the system after correction is:

$$\frac{E_b(s)}{E_i(s)}=\frac{1105(0.3s+1)^2}{S(0.027s+1)(2.1s+1)^2} \qquad (16)$$

The corresponding Bode plot is shown in Figure 6. The phase margin of the system after correction is:

$$\varphi_c(\omega_c) = 180° + 2\ tg^{-1}\ 0.3\ \omega_c - 90° - tg^{-1}\ 0.027\ \omega_c - 2\ tg^{-1}\ 2.1\ \omega_c \approx 45° \qquad (17)$$

Equation (17) shows that the system after correction is stable. Since the correction network, the equivalent motor system and the feedback network do not contain pure differential factors, one can conclude from equation (7) that with respect to speed control, this system is a first-order error-free system.

3.3 Starting Acceleration Circuit

In order to improve the film utilization of the remote sensor and to reduce the starting time for each operation, a starting acceleration circuit has been designed, as shown in Figure 8 (refer to Figure 7).

Because of the large time constant of the double poles of the correction network, the time required to charge the system to the operating point is quite long; this is particularly true for the second-stage correction network. The charge time constant for each stage is:

$$\tau_1 = (R_1 + R_2)C \qquad (18)$$

In the starting acceleration circuit, analog switches are used to close the charging circuit between the power supply and the points A, B during starting; when the system approaches the operating point, the switches are opened and the system enters a normal capture band. Since the time constant $\tau_2 = R_2 \times C$ is relatively short during this period, the starting time is reduced.

As shown in Figure 8, the switches K_1, K_2 are closed during starting, and are opened when the voltages at points A and B reach the operating point; the switch closing time is 0.5 sec. Using this circuit reduces the starting time to around 1 sec.

3.4 Pulse-Width Modulation (PWM)

The disadvantage of a conventional voltage-driven motor drive circuit is its large power consumption, which not only wastes energy but also imposes a burden on the temperature control system due to the large amount of heat generated. For this reason, a PWM circuit is used to reduce power consumption, as shown in Figure 9.

In this figure, e_1 is the power drive input; e_2 is the 2-kHz triangular wave.

Since the duty cycle of e_3 has a one-to-one relationship with the voltage e_1, and the frequency of the triangular wave is higher than the cut-off frequency of the motor, the transfer function of the PWM circuit can be regarded as unity. The actual measured power consumption is reduced by a factor of 1/3.

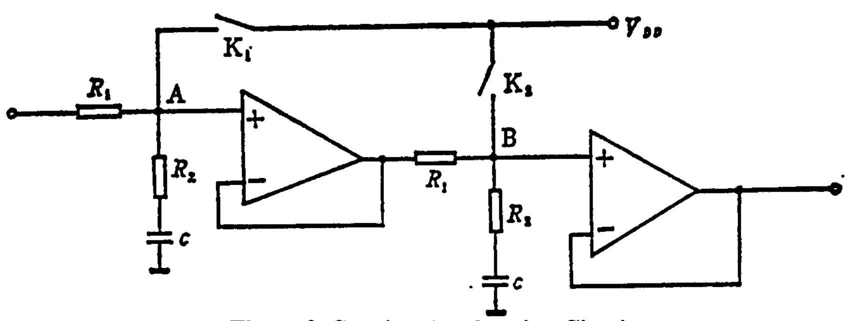

Figure 8. Starting Acceleration Circuit

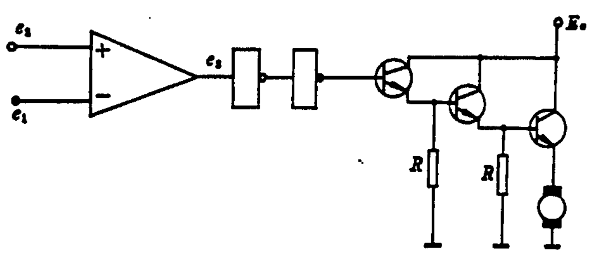

Figure 9. PWM Circuit

The measured performance parameters of the control system are:

Starting time	$t_s \approx 1$ s;
Range of motor speed control	40-80 r/s;
Phase lock accuracy (frequency gating time is 1 s)	0.05 percent.

4. Concluding Remarks

A PLL can be used in a remote sensor to meet the requirement of high-accuracy image drift compensation in order to obtain high-resolution images of ground targets. The PLL circuit introduced in this paper can meet these requirements not only for existing remote sensors but also for the next-generation remote sensors. From a system point of view, to meet the ever-growing demand for high-accuracy image drift compensation, it is not sufficient to focus only on high-accuracy PLL circuits; one should take a broader view by considering the electrical system, the mechanical system and the optical system as a large PLL.

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Use of Space Tether for Deorbit and Re-Entry

92FE0443A Beijing ZHONGGUO KONGJIAN KEXUE JISHU [CHINESE SPACE SCIENCE AND TECHNOLOGY] in Chinese Vol 12 No 1, Feb 92 pp 8-14, 32

[Article by Zhu Renzhang [2612 0088 3864] of the Beijing Institute of Spacecraft Systems Engineering: "Use of Space Tether for Deorbit, Re-Entry"; MS received 24 Sep 91]

[Text] **Abstract**

A space tether can be used to retrieve containers (test samples) from the space station (or space laboratory) into a re-entry orbit around the earth. By using a two-stage exponential deployment procedure and maximizing the deployment-speed-to-length ratio, it is possible to excite the tether to produce a large negative in-plane pitch velocity. This angular velocity can reduce the length of tether required for re-entry or improve re-entry performance.

1. Introduction

With the initiation of development efforts for spaceplanes and the space station, and the advances made in materials science, scientists in the aerospace community are actively studying the concept of using a space tether—first suggested by the Russian scientist Tsiolkovsky over a century ago—for conducting future scientific experiments in space and for other aerospace activities. In 1974, Colombo first proposed the idea of making long-duration scientific measurements using a 100-km-long tether to deploy a satellite from a spaceplane into a lower orbit. Since that time, a number of different ideas for using tethers and tethered satellite systems have been proposed. The use of a space tether in place of retro-rockets for re-entry application of recoverable containers is one of these examples. The idea of using a long rope to bring the test samples from a space laboratory or debris from a space station into re-entry orbits where they can either be returned to earth or be burned up in the atmosphere is very appealing. The technique is based on the principle of conservation of angular momentum of the tether and satellite system. Because of the urgent need for a space station (or space laboratory) and the successful experience in retrieving space objects, this concept of using a space tether for re-entry has a high probability of becoming a reality. There are two possible modes of releasing the recoverable container from the tether: a static mode and a dynamic mode. In the case of static release, the container maintains a steady position along the local vertical at the time of separation; in the case of dynamic release, the container is in an oscillatory motion behind the tether (opposite to the orbital motion) within the orbit plane. In the dynamic-release mode, it is possible to reduce the velocity of the container, and therefore the length of the tether at the time of separation. A key issue is designing a deployment procedure that would produce a large pitch velocity for the container when it reaches a certain altitude. This is the main topic of discussion of this paper.

Specifically, a two-stage exponential deployment procedure designed to excite the pitch velocity of the container at the time of separation is proposed. Computer simulations have been used to analyze the deployment procedure and to calculate the corresponding re-entry orbit. The simulated results show that the dynamic release resulting from this deployment procedure can indeed reduce the required length of the tether or improve re-entry performance.

2. Equations of Motion and Parameter Transformation

2.1 Equations of Motion of Tether Deployment

The equations of motion of tether deployment are given in Ref. 1. These equations take into account the effect of

aerodynamic drag on the space station, the container and the tether as well as the effect of mass variations of the space station and the tether.

2.2 Equations of Motion of Container Re-Entry

The equations of motion of container re-entry are given in Ref. 2. For heat-flux calculation, the following approximate formula is used[4]:

$$\dot{q}=C_F\rho V^3/4 \qquad (1)$$

where C_F is the "equivalent coefficient of friction," ρ is the air density, and V is the re-entry velocity of the container.

2.3 Parameter Transformation at the Point of Separation

From the equations of motion of tether deployment, the following parameters can be obtained: the radial distance of the center of mass of the tether-satellite system r_s, the angular velocity of the center of mass θ dot, the deployed length of the tether L, the in-plane pitch angle φ, the out-of-plane pitch angle β, and the rates of change of the above parameters $r_s$dot, L dot, φ dot, β dot.

The initial parameters for the re-entry motion of the container include the initial position and velocity coordinates X_0, Y_0, Z_0, V_{x0}, V_{yO}, V_{z0}.

Let L_p be the distance between the container and the center of mass of the tether system,

$$L_p = L(M_s + M_T/2)/(M_p + M_s + M_T) \qquad (2)$$

where M_s, M_p and M_T are respectively the masses of the space station, the container and the tether.

If the disturbances caused by separation of the tether and the container are ignored, then we have the following parameter transformation equations:

$$\left.\begin{array}{l}
L_{px}=L_p\cos\beta\sin\varphi \\
L_{py}=-L_p\cos\beta\cos\varphi \\
L_{pz}=-L_p\sin\beta \\
V_{Lx}=\dot{L}_p\cos\beta\sin\varphi-L_p\dot{\beta}\sin\beta\sin\varphi+L_p\dot{\varphi}\cos\beta\cos\varphi \\
V_{Ly}=-\dot{L}_p\cos\beta\cos\varphi+L_p\dot{\beta}\sin\beta\cos\varphi+L_p\dot{\varphi}\cos\beta\sin\varphi \\
V_{Lz}=-\dot{L}_p\sin\beta-L_p\dot{\beta}\cos\beta \\
V_{Ex}=\omega_e R\cos i \\
V_{Ey}=0 \\
V_{Ez}=\omega_e R[\cos^2\delta-\cos^2 i]^{1/2} \\
X_0=L_{px} \\
Y_0=L_{py}+r_s-R \\
Z_0=L_{pz} \\
V_{x0}=(r_s+L_{py})\dot{\theta}+V_{Lx}-V_{Ex} \\
V_{y0}=\dot{r}_s-L_{px}\dot{\theta}+V_{Ly}-V_{Ey} \\
V_{z0}=V_{Lz}-V_{Ez},
\end{array}\right\} \qquad (3)$$

where ω_e is the Earth's rotation rate, R is the radius of the Earth, i is the orbit inclination, and δ is the geocentric latitude of the origin of the ground coordinate system for re-entry motion.

3. Basic Strategy

The basic strategy is to excite the tether to produce the largest negative in-plane pitch velocity and use it for re-entry motion.

3.1 Deployment Speed-Control Method

If the ratio of tether deployment speed L dot to tether length L satisfies the following condition (Kulla, 1976):

$$\dot{L}/L<0.75n \qquad (4)$$

then the deployment is stable. Here, n is the mean orbit motion of the tether-satellite system. The speed-control method is simpler and easier to implement than the stress-control method, and therefore deserves primary consideration in conducting experiments in space. Of course, it cannot be used for retrieving an unattached tether; only the stress-control method should be considered.[1]

3.2 Conventional Three-Stage Deployment Procedure

The three-stage (exponential-uniform-exponential) deployment procedure is a feasible procedure for most applications.[3] In order to maintain continuity of L dot and L at the staging points, we use the following deployment formulas:

$$\begin{array}{lll}
\text{when} & L_0<L\leqslant L_1: & \dot{L}=C_1L \\
 & & L=L_0\exp[C_1(t-t_0)] \\
\text{when} & L_1<L\leqslant L_2: & \dot{L}=C_1L_1 \\
 & & L=L_1[1+C_1(t-t_1)] \\
\text{when} & L>L_2: & \dot{L}=C_1L_1-C_3(L-L_2) \\
 & & L=L_2+(C_1L_1/C_3)\{1-\exp[-C_3(t-t_2)]\}
\end{array}$$

Here L and L dot are respectively the length and the deployment speed of the undeformed tether; the values of t_0 and L_0 are set to be $t_0 = 0$, $L_0 = 10$ m; L_1 and L_2 are the lengths of tether at the staging points, and t_1, t_2 are the corresponding times. If the desired deployment length is L_f, then we must have $L_1 + L_2 \approx L_f$.

During the first stage, the tether can quickly reach a high deployment speed, but the in-plane pitch angle is quite large. After the second and third stages, the pitch angle decreases rapidly, so that the pitch angle and angular rate at the desired tether length become very small (see Ref. 1). This is a desired condition for most applications.

3.3 Two-Stage Deployment Procedure for Re-Entry Application

Re-entry application differs from other applications in that the negative in-plane pitch velocity can be exploited to reduce the orbit angular velocity of the container after separation. Therefore, our goal is to design a deployment procedure which maximizes the negative in-plane angular velocity at the desired tether length. Based on computer simulation results, we have obtained the following design guidelines:

1) By shortening or eliminating the second stage of the three-stage deployment procedure, the maximum value of the negative in-plane pitch rate absolute value of φ dot$_{max}$ can be increased. Therefore, for re-entry application, a two-stage deployment without the uniform-velocity stage is a viable candidate.

2) The maximum value of: absolute value of φ dot depends on the ratio C, where in this case $C = C_1 = C_3$; in general, absolute value of φ dot$_{max}$ increases with the value of C. Of course, C must be less than 0.75 n; for example, if the altitude of the space station is 450 km, then C must be less than 8.4×10^{-4}/s.

3) If we wish to achieve φ dot = - absolute value of φ dot$_{max}$ when the deployed length is L, then L is determined by the length L_1 at the staging point.

4. Simulation Results

In this section, L and L dot denote the actual length and deployment speed of the deformed (stretched) tether; the deformation depends on the elastic modulus of the tether material. Since the out-of-plane pitch angle β and its rate of change β dot are very small, their effect on the re-entry motion can be neglected. In the simulation, it is reasonable to assume that they are zero.

4.1 Basic Parameters

The mass of the space station is 2,000 kg; its reference drag area is 70 m^2. The mass of the re-entry container is 500 kg; its reference drag area is 3.14 m^2. The diameter of the space tether is 1 mm, and the mass-to-length ratio is 1 kg/km. The equivalent coefficient of friction is 0.01, and it has a longitudinal stability margin of approximately 5 percent.

4.2 Tether Deployment

The maximum value of the negative in-plane pitch velocity is not affected by the in-plane pitch angle and its rate of change.

A typical deployment procedure is shown in Table 1 and Figure 1. In this example, we have assigned the values $C_1 = C_3 = 8 \times 10^{-4}\ s^{-1}$, $L_1 = L_2 = 41$ km.

Table 1. Typical Deployment

T (h)	L (km)	$\dot{L}$ (m/s)	φ (°)	$\dot{\varphi}$ (°/s)	β (°)	note
0.000	0.010	0.008	0	0	0	initi.
0.184	0.017	0.014	14.2	0.0315	−0.003	$\dot{\varphi}_{max}$
0.759	0.089	0.071	41.7	0.0000	0.002	φ_{max}
1.119	0.251	0.201	39.7	−0.0021	0.001	
2.149	4.880	3.931	36.0	0.0000	0.000	
2.643	20.197	16.111	36.2	0.0002	0.000	
2.900	42.340	33.561	36.5	0.0004	0.000	$\dot{L}_{max}$
2.921	44.891	31.666	36.5	0.0000	0.000	
3.272	69.667	12.022	10.9	−0.0382	0.000	$-\lvert\dot{\varphi}\rvert_{max}$
3.292	70.519	11.344	8.1	−0.0382	0.000	$-\lvert\dot{\varphi}\rvert_{max}$
3.557	77.019	4.039	−14.4	0.0005	0.000	$-\lvert\varphi\rvert_{max}$
...	...	...	...	...	...	conti.

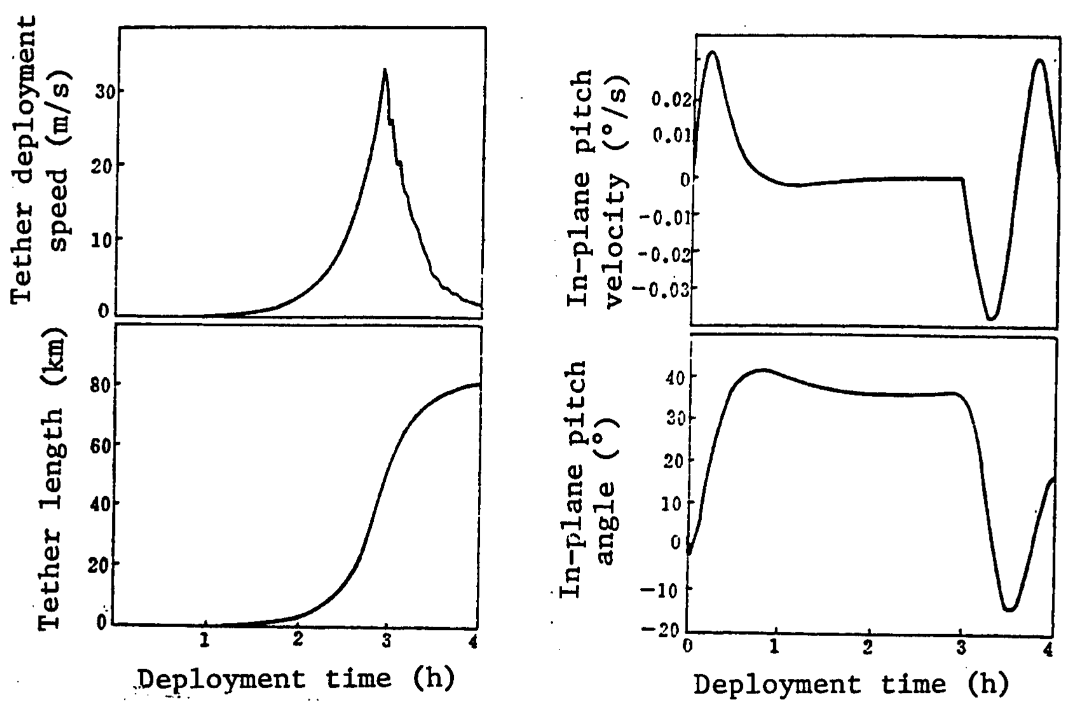

Figure 1. Deployment Procedure

It can be seen from Table 1 and Figure 2 that the maximum in-plane pitch velocity (minus absolute value of φ dot_{max}) can be maintained over a period of approximately 72 sec. This illustrates that it is feasible to use the in-plane pitch velocity for re-entry applications in practice.

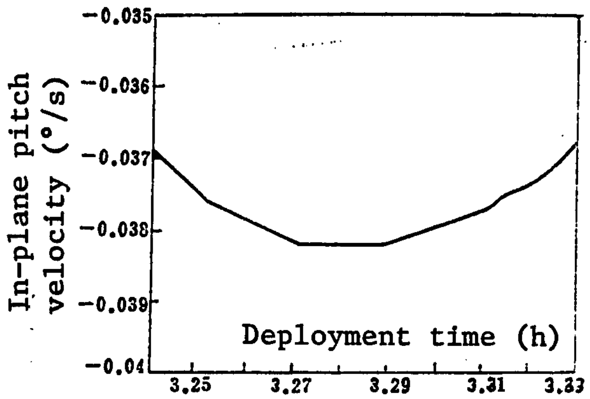

Figure 2. Minus absolute value of φ dot_{max} Versus T

4.3 Container Re-Entry

The key parameters of earth-orbit re-entry design for the container are: the re-entry flight time T (T = 0 when the container separates from the tether), the altitude H, the relative velocity v in the ground coordinate system, the flight path angle r (r > 0 when the velocity vector is below the local horizon), the angle of attack η, the heat flux per unit area q dot, and the heat load per unit area q. Tables 2-6 present the values of these parameters for some typical examples of re-entry motion using a space tether; the re-entry flight time of the container is limited to one orbital period. The parameter values shown in Table 2 correspond to the following deployment conditions: $C_1 = C_3 = 8 \times 10^{-4}$ s^{-1}; L_1 = 41 km; r_s = (449.94 + 6371) km; r dot_s = -0.0724 m/s; θ dot_s = 0.0642 °/s; L = 69.909 km; L dot = 12 m/s; φ = 10°, φ dot = -0.0382 °/s.

The parameter values shown in Table 3 correspond to the conditions: r_s = (449.94 + 6371) km, r dot_s = -0.0724 m/s, θ dot_s = 0.0642 °/s, L = 89.909 km, L dot = 12 m/s, φ = 0, φ dot = 0.

Comparison of Table 2 and Table 3 shows that if the re-entry flight time and other re-entry parameters are

Table 2. Parameter Values for the Case Where $-|\dot{\varphi}|_{max}$ Is Used

T (min)	H (km)	v (km/s)	r (°)	η (°)	$\dot{q}$ (10^4 J/m²/s)	q (10^4 J/m²)
0.0	374.6	7.119	0.156	89.844	0	0
24.5	90.0	7.463	2.134	0.546	3	65
25.7	69.3	7.241	2.194	1.252	85	2 097
26.9	48.6	4.946	3.754	0.512	383	18 803
27.0	45.3	4.269	4.467	0.391	387	22 694
27.9	29.3	0.999	16.168	0.118	50	33 672
30.6	0.0	0.097	89.819	0.000	3	34 845

Table 3. Parameter Values for the Case of Zero In-Plane Pitch Velocity and Long Tether

T (min)	H (km)	v (km/s)	r (°)	η (°)	$\dot{q}$ (10^4 J/m²/s)	q (10^4 J/m²)
0.0	355.2	7.140	0.094	89.906	0	0
24.8	89.0	7.458	2.001	1.591	4	82
25.9	70.7	7.268	2.058	1.171	71	1 817
27.1	51.0	5.339	3.330	0.469	352	16 302
27.3	47.8	4.750	3.900	0.410	377	19 950
28.3	28.7	0.908	17.485	0.009	42	33 747
31.0	0.0	0.094	89.824	0.000	3	34 826

Table 4. Parameter Values for the Case of Zero In-Plane Pitch Velocity and Constant Tether Length

T (min)	H (km)	v (km/s)	r (°)	η (°)	$\hat{q}$(10^4J/m²/s)	q (10^4J/m²)
0.0	374.6	7.161	0.093	89.907	0	0
33.1	90.2	7.494	1.053	0.023	3	120
35.4	70.3	7.112	1.221	0.936	71	3 388
36.9	51.2	5.034	3.319	0.274	287	18 454
37.2	44.9	3.931	4.822	0.339	318	24 635
38.1	28.7	0.919	17.578	0.075	43	33 989
40.8	0.0	0.094	89.872	0.000	3	35 080

Table 5. Parameter Values for the Case of Minimum Tether Length and Using $-|\dot{\Phi}|_{max}$

T (min)	H (km)	v (km/s)	r (°)	η (°)	$\hat{q}$(10^4J/m²/s)	q (10^4J/m²)
0.0	395.9	7.156	0.102	89.889	0	0
41.5	90.1	7.481	0.307	1.730	3	324
46.8	70.6	6.868	1.201	3.904	61	5 178
48.3	51.0	4.941	3.645	1.158	280	18 822
48.6	44.3	3.826	5.222	0.744	317	24 949
49.3	30.9	1.253	13.896	0.227	78	33 338
52.2	0.0	0.094	89.897	0.000	3	34 888

kept constant, then for zero in-plane pitch velocity, the length of the space tether must be increased (by approximately 20 km for this example).

The parameter values shown in Table 4 correspond to the conditions: r_s = (449.94 + 6371) km, r dot$_s$ = -0.0724 m/s, θ dot$_s$ = 0.0642 °/s, L = 69.909 km, L dot = 12 m/s, φ = 0, φ dot = 0.

Comparison of Table 2 and Table 4 shows that under the condition of zero in-plane pitch velocity and constant tether length, the re-entry flight time of the container will increase (by approximately 10.2 min for this example), and the heat load will also increase (by approximately 235 x 10^4 J/m^2 for this example).

The parameter values shown in Table 5 correspond to the following deployment conditions: $C_1 = C_3 = 8 \times 10^{-4}$ s^{-1}; $L_1 \approx 28$ km; r_s = (449.97 + 6371) km; r dot$_s$ = -0.0305 m/s, θ dot$_s$ = 0.0642 °/s; L = 48 km; L dot = 8 m/s, φ = 10°, φ dot = -0.0383°/s.

The parameter values shown in Table 6 correspond to these conditions: r_s = (449.97 + 6371) km, r dot$_s$ = -0.0364 m/s, θ dot$_s$ = 0.0642 °/s, L = 62 km, L dot = 8 m/s, φ = 0, φ dot = 0.

Comparison of Table 5 and Table 6 shows that if no attempt is made to excite the tether and use minus absolute value of φ dot$_{max}$, then the required minimum tether length must be increased (by 14 km for this example).

The above examples have demonstrated the feasibility of replacing the chemical propulsion system by a space tether to retrieve containers from space back to Earth. By using minus absolute value of φ dot$_{max}$, it is possible to reduce the length of tether by 22 percent without affecting the re-entry performance of the container.

Table 6. Parameter Values for the Case of Minimum Tether Length and Zero In-Plane Pitch Velocity

T (min)	H (km)	v (km/s)	r (°)	η (°)	$\dot{q}$(10^4J/m²/s)	q (10^4J/m²)
0.0	382.3	7.170	0.061	89.939	0	0
48.8	90.1	7.380	0.176	1.249	3	939
53.8	70.3	6.857	1.372	0.919	63	5 086
55.3	49.2	4.714	4.008	0.080	303	20 001
55.4	45.9	4.143	4.783	0.223	325	23165
56.3	29.3	1.014	16.356	0.061	53	33 475
59.5	0.0	0.097	89.850	0.000	3	34 680

5. Concluding Remarks

1) It is feasible to use a space tether for retrieving containers (or test samples) from a space station (or space laboratory).

2) An effective method for exciting the space tether to produce large negative in-plane pitch velocity is to use the two-stage exponential deployment procedure

$$L = L_0 \exp[C(t-t_0)] \qquad \text{for } L_0 < L \leqslant L_1$$

$$L = L_1\{2 - \exp[-C(t-t_1)]\} \qquad \text{for } L > L_1$$

and to increase the deployment-speed-to-length ratio. The resulting minus absolute value of φ dot_{max} can be used for container re-entry.

The author wishes to express his sincere thanks to Professor H. O. Ruppe and to his German colleagues at the Institute of Aerospace Technology, Munich Industrial University, for their support during the course of this work.

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Bank Gives Full Financial Support to Space Industry

40100054 Beijing CHINA DAILY (The Municipality) in English 1 Jun 92 p 2

[Article by Ji Peikai: "Bank Gives Full Support to Space Industry in Finance"]

[Text] The Shanghai Branch of the Industrial and Commercial Bank of China (ICBC) is giving full support to the production of the "Long March Three" carrier rocket.

The bank has agreed to a 31 million yuan ($5.6 million) loan to the Shanghai Aeronautical Bureau.

The special low interest loan will be used in the production of the ninth shot of the rocket.

"The low interest loan will be able to further reduce the production cost of the rocket and increase its competitiveness on the world market," said an ICBC Shanghai official.

ICBC Shanghai already provided some 54.50 million yuan ($9.9 million) in such special low interest loans for the production of the "Long March Three" carrier rocket in 1990 and 1991.

The "Long March Three" carrier rocket, designed independently by China with many parts produced in Shanghai, successfully sent the Asia One satellite into orbit on April 7, 1990.

ICBC Shanghai also has shown its key support for the aeronautical bureau, a military bureau which has converted a high proportion of its production to civilian uses.

During the first 4 months of this year, ICBC Shanghai has provided 450 million yuan ($82 million) in circulation fund loans for the bureau, 57.1 percent of its circulation fund.

Most of these loans have been used in the production of color TV sets, refrigerators, washing machines and air conditioners.

Wang Yuchun, deputy governor of ICBC Shanghai, said his bank will continue to provide key support to the production of high-tech products.

The Improvement of Mechanical Properties of ZTM Ceramics by Heat Treatment and Deep-Cool Treatment

40100056A Beijing GUISUANYAN XUEBAO [JOURNAL OF THE CHINESE CERAMIC SOCIETY] in Chinese Vol 20 No 1, Feb 92 pp 8-15

[English abstract of article by Jin Zhengguo, Wang Zhanmin, Xu Mingxia, Chen Yuru, and Yuan Qiming of the Department of Materials Science and Engineering, Tianjin University; MS received 6 Sep 90]

[Text] Ultrafine mullite powder of high purity was prepared by the hydrolysis-precipitation method, in which the toughening additives $ZrO_2(Y_2O_3)$ or ZrO_2 $(Y_2O_3/Al_2O_3$ were introduced as seed crystal by wrapping method. The mullite crystallization and densification of the composite were simultaneously completed by hot pressing at lower temperatures ($\leq$1460°C). Using heat treatment at various temperatures and atmospheres to change the stability of the t-ZrO_2, the room-temperature mechanical properties of the mullite/TZP composite could be enhanced. The appropriate heat treatment could reinforce the mechanism of stress-induced transformation in the composite; thereby, this led to an increase in the values of the fracture toughness and bending strength by 105 percent and 34 percent respectively. The surface compressive stress strengthening associated with deep-cool treating technique was also investigated. The deep-cool treatment technique could enhance the bending strength of ZTM composite. The cooling treatment of 5s per cycle by 5 cycles increased the strength values by 36 percent. The combination of heat and cooling treatment promoted the strength by 48 percent.

Dielectric Properties and Defect Structure of $Sr_{1-x}La_xTiO_3$ Ceramics

40100056B Beijing GUISUANYAN XUEBAO [JOURNAL OF THE CHINESE CERAMIC SOCIETY] in Chinese Vol 20 No 1, Feb 92 pp 23-28

[English abstract of article by Zhi Yu (Materials Science and Engineering Department), Chen Ang (Physics Department) of Zhejiang University, Zhang Xuli, Wang Xiaozhen, and Li Biaorong of Huazhong [Central China] University of Science and Technology; MS received 26 Nov 90]

[Text] The dielectric properties of $Sr_{1-x}La_xTiO_3$ ceramics ($0 \leq x \leq 0.06$) were measured in a frequency range from 10^3 to 10^7 Hz at 25°C. The results show that the dielectric properties and the charge compensation mechanism vary obviously with La content. When $x < 0.02$, the charge compensation is achieved by quasi-free electrons and strontium vacancies in the materials. The inhomogeneous distribution of quasi-free electrons causes the space-charge polarization and the dielectric relaxation in the range of 10^5-10^7 Hz. When $0.02 \leq x \leq 0.06$, the ionized lanthanum is compensated by strontium vacancies and the relaxation phenomenon disappears in the tested frequency range.

Positron annihilation technique (PAT) was adopted to study the defect structure further. The lifetime spectrum measured clearly indicates that the defect model for different La contents is reasonable.

Research on Sintering Kinetics of Ultrafine ZrO_2-Y_2O_3 Powder

40100056C Beijing GUISUANYAN XUEBAO [JOURNAL OF THE CHINESE CERAMIC SOCIETY] in Chinese Vol 20 No 1, Feb 92 pp 35-41

[English abstract of article by Xu Yueping, Guo Jingkun, and Huang Xiaoxian of the Shanghai Institute of Ceramics, CAS; MS received 7 Jun 90]

[Text] The densification mechanism of ultrafine ZrO_2-Y_2O_3 powder is studied. The experimental results show that grain boundary diffusion plays an important role in the initial stage of sintering. The effects of agglomerates on the densification process are analyzed. It was found that the interaction of the interface stress between the agglomerate and matrix decreases the density of the agglomerates and influences the microstructure, as well as preventing the potential growth of fine crystallites in the final stage of sintering. Agglomerate-free powder was sintered to attain 98.5 percent of theoretical density at 1250°C for 2h when the resulting grain size was only 160 nm.

Agglomeration Control in the Preparation of Ultrafine ZrO_2 (Y_2O_3) Powder by Means of Wet-Chemical Process

40100056E Beijing GUISUANYAN XUEBAO [JOURNAL OF THE CHINESE CERAMIC SOCIETY] in Chinese Vol 20 No 1, Feb 92 pp 48-54

[English abstract of article by Xu Dichun, Hao Xiaochun, and Zhu Xuanhui of Materials Science and Engineering Department, Tianjin University; MS received 26 Nov 90]

[Text] By means of Raman spectroscopy, IR spectroscopy, DTA, TEM, SEM and electrokinetic method, agglomeration control in ultrafine ZrO_2 (Y_2O_3) powder prepared by wet chemical process has been studied. The experimental results show that during the precipitation process the electrostatic and steric effect can be intensified by high-polymer additives and a uniformly dispersed colloidal suspension is obtained. After washing, the interface structure of colloidal particles of wet gel, treated by surfactant, is improved and formation of hard agglomeration in drying and calcinating is prevented. Furthermore, the effect of powder agglomeration on the properties of the fired samples is studied.

Nucleation and Growth Process of SiC Ultrafine Powder

40100056D Beijing GUISUANYAN XUEBAO [JOURNAL OF THE CHINESE CERAMIC SOCIETY] in Chinese Vol 20 No 1, Feb 92 pp 42-47

[English abstract of article by Xu Yuqing and Ding Zishang of the Materials Science and Engineering Department, Zhejiang University, Wang Youwen and Yao Hongnian of the Central Laboratory, Zhejiang University; MS received 9 Nov 90]

[Text] Regarding the structure of SiC ultrafine powder synthesized by the thermal chemical vapor-phase reaction method, there remains unstudied a lot of characteristics associated directly with the nucleation and crystal growth. It is favorable to conduct a high-resolution electron microscopy (HREM) study of the process of nucleation and crystal growth. The main mechanism of forming SiC ultrafine powder—the process of homogeneous nucleation and growth—is discussed. The process includes five procedures: formation of SiC amorphous nuclei; spiral growth of SiC and its obstruction; crystallization of metastable SiC whirlpool; agglomeration; formation of amorphous SiC on the particle surface. Moreover, the heterogeneous nucleation and epitaxy of SiC on solid Si and the carbonization of solid Si are also analyzed.

China Battles Killer Diseases

40101019C Beijing CHINA DAILY (BUSINESS WEEKLY) in English 18 May 92 p 4

[Article by Xie Yicheng: "China Battles Killer Diseases"]

[Text] China's vaccine industry is undergoing an unprecedented technological revolution.

A massive infusion of capital from home and abroad is streaming into the vaccine industry, which seeks to free 360 million Chinese children from the threat of infectious diseases through inoculation.

The Ministry of Public Health will invest more than 500 million yuan ($93 million), including $60 million worth of World Bank loans and international grants, to build seven vaccine production lines. The mammoth innovation campaign is aimed to guarantee immunizations for all children and to boost China's level of biological sophistication overall.

A Dutch engineering firm named DHV Consultants has won a major piece of the contract to put the programme into trial operation in 1995.

A subcontractor—the National Institute of Public Health and Environmental Protection of the Netherlands—will offer state-of-the-art technology on vaccine manufacturing.

Vaccine quality is supposed to reach the level specified by the World Health Organization (WHO).

The project is believed to be one of the world's largest technical innovation and technology transfer programmes ever involving biological products.

Of the seven production lines, three will be located within the Lanzhou Institute of Biological Products. They hope to achieve an annual output of measles vaccine (MV) of 20 million doses, 1 billion doses of diphtheria, pertussis & tetanus toxoid (DPT) vaccine and 40 million doses of tetanus toxoid vaccine.

Another three production facilities are to be built at the Shanghai Institute with similar capacities. The remaining facility will be erected in Kunming Academy of Medical Science & Biology to produce 100 million doses of oral polio vaccine (OPV) each year.

WHO's expanded programme on immunization has targeted measles, polio, pertussis, diphtheria, tetanus and tuberculosis as the major threat to the health of infants and children.

China is preparing to give anti-epidemic inoculations to more than 85 per cent of children in towns and villages by 1995.

The effort is intended to wipe out polio and neonatal tetanus, which are among the major causes of death for children in remote and poor rural areas, by 1995.

China also started speeding up technical innovation in another four biological manufacturing bases in 1988 at a cost of 230 million yuan ($43 million).

The bases are located within Beijing, Changchun, Chengdu and Wuhan Institutes of Biological Products.

China hopes the completion of the various vaccination projects by 1995 will make its entire vaccination system much more rational nationwide.

By then, it is hoped that every two biological manufacturing bases will shoulder the modern industrialized production burden of a specific kind of vaccine intended to satisfy specific market needs, especially the inoculation needs of 20 million new-born babies each year.

Chinese officials say there is also the possibility China could export vaccine to some developing countries that are still unable to produce vaccine for themselves.

While China has made significant progress in producing some vaccines, the quality of China's vaccine products is not up to standards set by the World Health Organization.

Poor quality has sometimes adversely affected the performance of some of China's vaccines.

In 1989, for instance, 1,000 cases of polio broke out in several provinces such as Jiangsu.

Chinese officials blamed the low quality of vaccines to simple, manual production techniques still in use, obsolete technology and unclean animals used in some experiments.

Medical Industry To Regain Lost Glory

40101019B Beijing CHINA DAILY (The Municipality) in English 19-25 Apr 92 p 3

[Article by Yang Wenhua, CD staff reporter: "Medical Industry To Regain Lost Glory"]

[Text] Once a leader of the country's medical industry, Shanghai is launching a two-pronged effort to regain its leading position in the 1990s.

The efforts include constructing a group of new modern medical enterprises in Pudong New Area, and readjusting the organization and administration systems of present medical enterprises.

Efforts have been made to re-organize the structures of enterprises to form a reasonable cross-section of enterprises of different economic scales and to achieve greater efficiency.

Presently, most medical instrument factories are located in the urban area, where they suffer from lack of space and poor production facilities. As a result, the products are not of a high quality and the equipment and funds are not being used efficiently.

To change this situation, the Municipal Pharmaceutical Administration Bureau has been exploring various ways to re-organize the enterprises. Last year, the bureau combined its four pharmaceutical machinery factories into a new general factory. Shanghai Chinese Traditional Medicine Corporation was reformed into a industrial corporation, making it not only a commercial corporation but also a productive enterprise. As well, three Chinese traditional medicine factories and one medical machinery factory joined the corporation.

This year, the bureau plans to combine some western medicine factories and form several medical groups and a medical conglomerate. As the first step in the plan, this year nearly 10 factories will be absorbed into the conglomerate.

In the medical packaging industry, this year the first step will be taken toward reform: the No. 4 Glass Factory will be absorbed into the Shanghai Glass Factory, with new technology imported to produce upgraded glass packaging.

Most of the re-organized or newly combined enterprises will be located in Pudong New Area.

Recently, the bureau has worked out a plan to develop high-tech and high-efficiency pharmaceutical enterprises in Pudong New Area's Jinqiao Processing and Export Zone, and two other areas, namely Zhangjiang and Junlu.

The bureau will invest 80 percent of its total investment in the Eighth 5-Year Plan (1991-95) to make these changes. At that time, groups of modern export-oriented pharmaceutical industrial enterprises will be set up in Pudong New Area, along with some medical research institutions and some trade corporations.

The bureau will try to move the old enterprises to Pudong New Area and upgrade them using foreign funds. In the Jinqiao Processing and Export Zone, a group of medicine factories will be set up. Some old enterprises, namely Sine, Haipu, Huanghe, and Tianfeng medicine factories, will import new technology, products and funds from Taiwan, Hong Kong, and Singapore to build new factories that meet international standards, hoping to upgrade their products and enlarge exports.

Close to Jinqiao Processing and Export Zone is the Junlu area, where New Asia Medicine Factory will invest 73.5 million yuan ($13.6 million) in production of vitamin B6, which sells well in the world market. Besides, Wuzhou Medicine Factory, Shanghai Glass Factory and the Chinese and Western Medicine Corporation will also open branches in this area.

In Pudong's Zhangjiang High-tech Zone, Shanghai No. 3 Medicine Factory will invest over 200 million yuan ($37 million) to establish a large modern factory producing the latest generation of antibiotic.

The bureau will also build some medical trade centres in Pudong, such as the Medical Trade Exhibition Building and the Chinese Traditional Medicine Trade Building, in order to promote the trading of medical products in Pudong New Area.

Low-Cost Method Found To Grow Bacteria for Pesticides

40101019A Beijing CHINA DAILY (Science and Medicine) in English 4 May 92 p 5

[Article by Gao Anming: "Low-Cost Method Found To Grow Bacteria for Pesticides"]

[Text] At a time when people all over the world are becoming increasingly conscious of the environment, traditional chemical pesticides are being replaced by more efficient, low-toxic agents.

Pesticides made from bacillus thurigiensis, a bacteria produced through artificial fermentation, have become quite popular in recent years because they kill such pests as pine moths and bollworms without causing pollution or harming the pests' natural enemies.

Liang Jichun, a young technician from Hebei Province, said he has developed a fermentation process which turns out high-quality bacteria at low cost.

In most developed countries, where this biological pesticide is widely used, the bacteria is cultured from a liquid medium in fermentation tanks. While fermentation can be easily controlled in vats, it is very expensive because of the sophisticated technology involved.

Liang, who works for the Helingfeng agrotechnical service centre in Zhuozhou, Hebei Province, told a press conference last month that after four years of experiments using a solid rather than a liquid medium, he had developed techniques that successfully control temperature, humidity and unwanted bacteria during fermentation. These had previously been the biggest stumbling blocks to large-scale bacillus production from a solid.

Liang, in co-operation with Song Peng, now a manager of the Beijing-based Column Computer Equipment Co., cultured the bacteria from new, solid materials on specially designed platforms in insulated houses. He uses air conditioners to keep the temperature and humidity constant.

He said the potency of his bacillus, though fluctuating within a 15 per cent range, is 50 percent higher than that produced from liquid media in developed countries and at least two times higher than the advanced domestic average. The production cost, however, is lower than anyplace else in the world.

Liang declined to disclose details of his invention, saying he is applying for patent.

"The solid medium fermentation process is simple in design but technically advanced. Because it turns out products of a high and consistent potency, this technique

is superior to other ways of producing bacillus thurigiensis in China," said Luo Shaobin, associate research fellow with the Wuhan Virus Institute of the Chinese Academy of Sciences.

"Liang is to be commended for combining non-biological methods of advanced technology with primitive local methods," said Zhong Liansheng, an associate research fellow with the Plant Protection Institute of Hubei Provincial Academy of Agricultural Sciences.

Both Luo and Zhong took part in the national research programme on the bacillus for the Seventh 5-Year Plan (1986-1990).

The two scientists stressed, however, that Liang's invention is still at the laboratory stage, and called for further experiments to gather more data and more research on the processing techniques, so that the invention can be put into large-scale commercial production as soon as possible.

Bacillus thurigiensis kills pests by destroying their digestive systems. It leaves no toxic waste, and is harmless to the pests' natural enemies such as birds, according to Wu Shixiong, deputy director of the biological testing office of the Pesticide Examination Institute.

While pests may grow accustomed to most chemical insecticides, it is quite difficult for them to become immune to a bacterial agent, Liang said.

The pesticide kills or controls pests affecting trees, rice, cotton, maize, vegetables, tea and tobacco. It can deal with 90 percent of forest pests in Canada and half of maize pests in the United States, said Liang, a law major graduate from Shangdong University in 1986.

200 MIPS-Class Intelligent Workstation Developed

Main Description Provided

92P60304A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 15 May 92 p 1

[Article by Fan Jian [5400 1696]: "Major Breakthrough in Nation's [Development of] Intelligent Computers"]

[Summary] A project to develop a "parallel graph reduction intelligent workstation," one of the three key projects in the intelligent computer area of the "863" Plan, has been completed by scientists at the Computer Department of Qinghua University. The experts have appraised this achievement and product as being at the current international state-of-the-art. For the first time worldwide, a distributed-memory parallel system which simultaneously supports functional language and parallel logical language, as well as procedural language, has been developed—an achievement which gives a huge boost to domestic R&D of parallel computing, artificial intelligence technology, and intelligent computers. The system has a compiler supporting explanatory language for symbolic operations and common program language. This workstation system has a maximum of 16 processors in simultaneous operation; each processor works on a part of the task, thus greatly increasing computing speed.

Additional Details Released

92P60304B Beijing RENMIN RIBAO in Chinese 17 May 92 p 1

[Article by Jia Xiping [6328 6007 1627]: "High-Performance Intelligent Workstation Developed"]

[Summary] According to the explanation given by the experts, the "parallel graph reduction intelligent workstation" developed by Qinghua University specialists is a step-by-step simplified high-performance general-purpose artificial intelligence computer system with a peak operating speed of 240 MIPS [million instructions per second].

New Breakthroughs in Applications of Fuzzy Logic Reported by Beijing Teachers' University

92P60303 Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 12 May 92 p 1

[Article by Tang Dongning [3282 2639 1337] et al.: "New Breakthroughs Made by Fuzzy Mathematics Institute at Beijing Teachers' University"]

[Summary] Four years after their development of China's first fuzzy inference engine discrete-component prototype computer [see JPRS-CST-88-014, 25 Jul 88 pp 116-117], modeled after the world's first such prototype, developed by the Japanese Prof. T. Yamakawa, a group of Ph.D. students led by Prof. Wang Peizhuang [3076 1014 8369] of the Fuzzy Mathematics Institute at Beijing Teachers' University has reported the world's first realization of simulated control of a three-level inverted pendulum. This major achievement in sophisticated new-generation [i.e. sixth-generation] computing has aroused international attention, and raised expectations for applications of fuzzy logic, as well as giving an enormous boost to China's competitive ability in the international computing arena.

Since the late Seventies, Prof. Wang, the leading Chinese authority on fuzzy set theory and applications, has published three treatises and over 90 papers (including 35 in international journals) in the field of artificial intelligence. Prof. Wang is currently the leader/advisor of a group studying "Fuzzy Information Processing & Machine Intelligence", under a grant from the Natural Science Foundation of China. In their laboratory, which is now a State Specialized Laboratory for Fuzzy Information Processing and Fuzzy Computer Systems, the group is now devoting itself to the internationalization and commercialization of fuzzy mathematics research and applications, especially in the area of electrified railway maintenance/monitoring and home electrical products. Laboratory technical director Dr. Bai Ming [4101 2494] stresses that Prof. Wang continues to encourage group members to set their sights on remaining competitive on the world market. Prof. Wang's direct influence extends abroad: two of his former graduate students set up their own company in California's Silicon Valley in 1989 and have already developed and marketed a new fuzzy logic software package.

Seventh National AI Conference Held at Xian University

92P60319 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 19, 13 May 92 p 93

[Article by Wu Xinzhan [0702 2450 4232] of the Board of Directors, China Artificial Intelligence Society: "On the 7th National Artificial Intelligence Conference, Commemorating the 10th Anniversary of the Founding of the China Artificial Intelligence Society"]

[Summary] The 7th National Artificial Intelligence (AI) Conference (CAAI-7), commemorating the 10th anniversary of the founding of the China Artificial Intelligence Society (CAIS), was held at Xian [Northwest] Polytechnical University 14-19 April 1992. Over 170 AI experts, professors, scientists/engineers, and graduate students from across the nation attended. CAIS Board Chairman Tu Xuyan [3205 1645 1750] delivered an address entitled "Theory, Methods, and Technology of AI—Reassessing the Development Paths and Methodology of AI". Theoretical subjects such as "generalized intelligent information systems theory" oriented towards unified AI theoretical systems and practical

subjects such as IC technology "integrating general-purpose and special-purpose parallel software and hardware" were discussed. Particular areas of interest included intelligent computer interfaces, artificial neural networks and their applications, knowledge acquisition and machine learning, logic and automatic inference, knowledge engineering and expert systems, intelligent control/management, intelligent CAI systems, and intelligent robotics. One especially advanced topic, discussed by conference Secretary-General Assoc. Prof. Yuan Meng [5913 5492], was the integration of fuzzy logic technology with artificial neural network technology in developing new-generation [i.e. sixth-generation or seventh-generation] intelligent computers. Specifically, Prof. Yuan proposed a fuzzy neural network consisting of fuzzy flip-flops and other fuzzy elements and having adjustable memory parameters; this type of neural network would have parallel processing functions and easily implemented learning algorithms.

Qinghua Develops Multifont, Full-Symbol-Set Printed Chinese-Character Recognition System

92P60286B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 6 May 92 p 1

[Article by Tang Dongning [3282 2639 1337]: "Qinghua Develops Multifont, Full-Symbol-Set Printed Chinese-Character Recognition System"]

[Summary] The OCR [optical character reader] multifont, full-symbol-set printed Chinese-character recognition system developed by Qinghua University's Electronic Engineering Department as an "863" Plan project recently passed the technical appraisal sponsored by the State Education Commission. The system includes five low-security floppy disks and one security card and requires a scanner. Field-tested and perfected for over a year, this system now has a recognition speed of 10-30 characters per second and a usual recognition accuracy of 95-99 percent.

Reports on New Anti-Virus Hardware

Huaxing Ltd. Announces Second-Generation Card

92P60271F Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 29 Apr 92 p 1

[Article by Dai Gang [2071 6921]: "Second-Generation Microcomputer Virus Protection Card Unveiled"]

[Summary] Shenzhen's Huaxing S&T Ltd. has announced the development of its second-generation virus protection card, "ViruStop Plus." The new card, based on the phenomenally successful first-generation products (HX-008 and HXVPC] put out in the past 2 years for foreign and domestic consumption, is designed to be compatible with some recent prevalent software packages, such as Windows 3.0, Dos5.0, and Novell Netware. In addition, the new card has enhanced functions and incorporates independently designed foreign-made VLSI ASICs. These VLSI circuits greatly increase reliability and reduce power consumption (down to one-fourth that of the first-generation products).

More Details on Huaxing's ViruStop Plus

40100057 Beijing CHINA DAILY in English 9 Jun 92 p 5

[Articled by Zi Yang: "Hardware Cure for Computer Viruses"]

[Text] Ever since computer viruses were first detected in the early 1980s, scientists around the world have racked their brains to find a way to eliminate them. Most treatments are software-based, such as the regular use of floppy disk detectors to check and clear the computer system. Nevertheless, viruses have still been multiplying at an alarming rate in recent years.

But a Chinese compnay may have found a better cure.

A young computer researcher has developed the ViruStop Plus PC Immunizer Card with Huaxing Science and Technology Co Ltd in Shenzhen Special Economic Zone.

"The old saying 'Prevention should come before treatment' is what has inspired the idea of creating a hardware product to treat viruses," said Yang Zhenyu, the company's deputy chief engineer.

Built on a tiny board to fit in a computer, the card can eliminate boot sector virus invasion and prevent the infection and proliferation of file-infecting viruses.

When the computer is turned on, the card works immediately to fight viruses. Because it is hardware, it does not occupy any RAM area or interfere with computer operation. Unlike a software detector that can also be infected with viruses, the new card cannot be touched because it does not carry files.

"Immunization is the whole secret of this card. It can prevent the invasion and spread of several hundred viruses known to exist in the world," said the 28-year-old Yang, a 1991 graduate of the famous China Science and Technology University in Anhui with a doctor's degree in nuclear electronics.

It was in 1989 when he was still a university student that Yang began to cooperate with Huaxing Science and Technology Co Ltd in Shenzhen on the research of a new computer virus detector.

In January 1990, he produced the first card and brought it to the United States, where the computer virus control authority, McAfee Associates, tested it twice against 277 known computer viruses.

The card prevented all of them.

Four months later, his invention passsed a State technical appraisal organized by the Ministry of Space and Aeronautics Industry. It was hailed as "the first of its kind" in China, and perhaps in the world.

Since then, Yang's card has been used with success in many important institutions: the Information Center of the State Planning Commission; the State Statistical Bureau; the Shenzhen Special Economic Zone Daily; the Guangdong Dayawan Nuclear Power Plant; and the Bank of China branch in Hong Kong.

Encouraged by his initial success, Yang has been improving his anti-virus cards and has made 15 upgraded versions.

In 3 years, more than 20,000 cards have been sold at home and in the United States, Britain, Australia, Canada, Singapore and Switzerland.

ViruStop Plus PC Immunizer Card

[Photograph from Beijing JISUANJI SHIJIE in Chinese No 20, 20 May 92 p 68]

Nanjing Firm Develops New Microcomputer Card

92P60286A Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 18, 6 May 92 p 2

[Article by Gao Lihua [7559 7787 5478]: "Jiangsu Develops 'Xinchuang' SVG Microcomputer Virus Protection Card"]

[Summary] The "Xinchuang" SVG microcomputer virus protection card developed by Nanjing's Xinchuang [2450 0482] Electronics Ltd. passed the technical appraisal held on 11 April by the Jiangsu Province Public Security Office. According to the experts, this intelligent virus protection card, suitable for individual computers and for LAN-interconnected computers, not only protects microcomputers from boot-sector viruses (as do other domestically made virus protection cards), but also is the nation's leading product in protection against file-type and hybrid viruses. The card incorporates artificial intelligence technology permitting dynamic real-time monitoring, evaluation, tracking, decision-making, and alarm generation. Specifically, the card comes with a composite multilayer intelligent protection system, as "intelligentized" expert system, a virus behavioral process determination knowledge base, a hardware card encryption system, and an accurate alarm indicating mandatory strict precautions to be taken; this card also includes treatment functions to rid the microcomputer of existing and future "intelligent" viruses.

Ruixing Card Reaches International Standard

40100059 Beijing XINHUA Domestic Service in Chinese 0911 GMT 9 Jun 92

[Article by Gu Honghong [7357 3163 3163]: "Anti-Viral Computer Card Reaches International Standard"]

[Text] Beijing, 9 June (XINHUA)—The Chinese computer industry's work in microcomputer anti-viral methods has reached leading international standards. The Ruixing anti-viral card, representative of this standard, recently proved itself in an international on-line test conducted by Qinghua University. Three functions of this anti-viral card were all found to be world firsts: the ability to warn of the presence of a virus, to automatically purge existing viruses, and to ensure safe operating procedures while carrying the virus.

Computer viruses have become a global public nuisance. China's computer industry is also severely troubled by viruses and suffers huge losses in human, financial, and material resources every year as a result. After analyzing the disruptive mechanism of numerous viruses, scientists at the Beijing Ruixing Computer's technology development department came up with an all-new "rapid virus identification" theory, and developed an anti-viral card by focusing solely on preventing the spread of a computer virus to a higher grade, which thus prevents the spread of the virus and prevents the disruption of viruses. Technically the Ruixing anti-viral card exercises multi-level control on the virus in three ways: it automatically identifies the virus as soon as it enters the internal storage and issues a warning, it automatically purges the virus from internal storage, and it ensures safe operating procedures while carrying the virus.

The reporter learned that the Ruixing anti-viral card successfully survived the test of the highly destructive "Michelangelo" and "Black Friday" viruses in March; hence, tens of thousands of Ruixing users have been spared from suffering any damage. At the same time, tests conducted by the Public Security Department have determined that the Ruixing anti-viral card can successfully prevent the highly destructive DIR-2 virus.

The Ruixing anti-viral card passed the appraisal of relevant departments in Beijing today. The appraising committee, comprised of renowned Chinese computer experts, unanimously held that the design concept of the Ruixing anti-viral card is both advanced and innovative, and all of its three major functions meet leading international standards.

Computer Chip Promising for Character Processing

*40100050A Beijing CHINA DAILY in English
21 May 92 p 2*

[Article: "Computer Chip Seems Promising"]

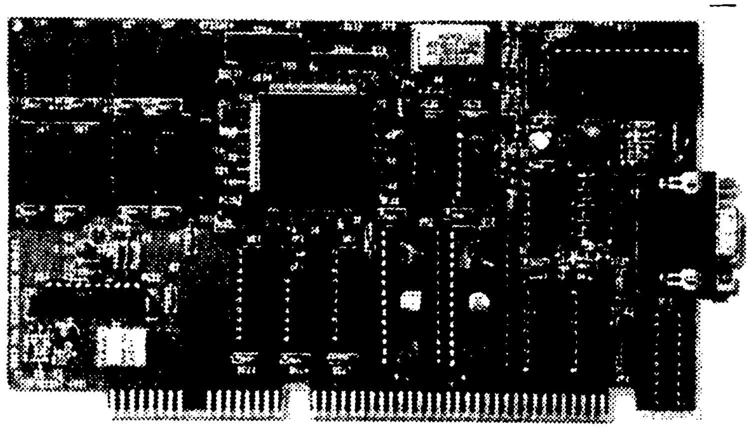
[Text] A breakthrough in computer technology is being introduced in China to make it easier to process Chinese characters on computers. Unlike other Chinese display cards, the Chinese Super VGA Card, developed by the Beijing Legend Computer Group Company, integrates all the Chinese processing functions on just one microchip. So it is no longer a separate card but just a tiny component that can be fitted on an ordinary VGA display card.

With an operating speed of one microsecond per character, it is the fastest Chinese card available, and has special circuits for speeding up applications in Windows and other graphics environments. It is also the most compatible of all Chinese cards, said Ni Guangnan, the chief engineer at Legend.

"This is the first time in the world that both Chinese processing and display capabilities have been successfully integrated on a microchip of only about one square inch, but with 21,000 gates for high-quality performance," Ni said. It is a great improvement over earlier models of Legend Chinese cards that have to use much larger circuit boards installed separately from the display cards.

The new Legend card can be used with any printers and PC compatibles, including 486-level computers, and supports most original software directly without any modification.

It is one of 15 computer products that have been developed for the 1992 market by Legend, one of the largest high-tech computer companies in China. Other innovations for the year include the Legend 486/33 EISA, Legend 486/50 EISA computers and Legend Chinese Inkjet Printing Systems.



The new Chinese Super VGA Card, as shown above, was developed by the Beijing Legend Computer Group Company. It integrates all the Chinese processing functions on just one microchip. Fitted at the center of the display card in the picture above, the chip is just about two square centimeters. It marks the first time Chinese processing has been successfully integrated into a display card this small. [photo by Li Lan; Beijing CHINA DAILY in English 9 Jun 92 p 5]

Hand-Held Computer Functions as Desktop

*40100052A Beijing CHINA DAILY in English
3 Jun 92 p 5*

[Article by Lao Qie]

[Text] Chinese scientists have developed an advanced hand-held computer that can perform the same general functions as a personal desk computer.

The computer, as big as an ordinary pocket novel (19.5 cm by 8.6 cm by 3.5 cm), is the latest product of the Zhen Zhong Computer Disk Company, of the Institute of Computing Technology under the Chinese Academy of Sciences (CAS). It can display in both Chinese characters and English.

The hand-held computer is now used by hospitals, police, electricity and water supply departments, restaurants, post offices and cartographers.

"The computer is highly capable of handling a data bank. It can be connected with personal computers and printers, and can carry out long-distance communications through MODEM," said associate professor Yin Yanzhi, the chief developer of the hand-held computer.

The computer uses four AA batteries, has a memory of 64K and can work continuously for 40 hours, Yin said.

Hu Wangen, general manager of the company, says they have sold more than 200 such hand-held computers in China so far this year for about 2,300 yuan ($420) each.

"The Chinese character display system in our computer is very competitive," Hu said.

In Inner Mongolia, police used the hand-held computers to find missing bicycles in the street, Hu said.

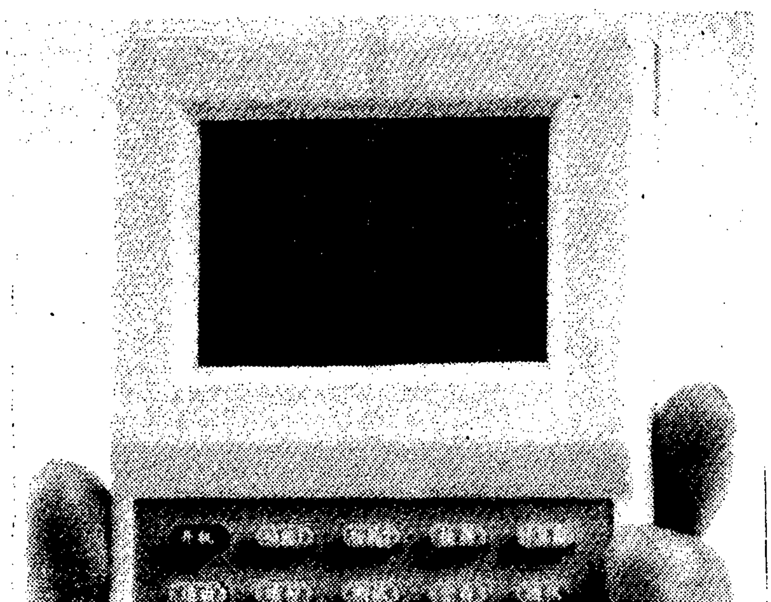
"Police there told us the computers make marvelous detectives," Hu said.

The hand-held computer is believed to be the best of its kind in China, although it is three years behind the best in the world. It won a gold medal at the International Fair held in Beijing in April this year.

Also, the hand-held computer can recognize bar coding, which is becoming popular in China.

Some Taiwan companies have contacted the Zhen Zhong company to promote bar coding in Hong Kong, Taiwan and foreign countries, Hu said.

Although the hand-held computer is one of the hottest products in compute technology, the world's most advanced model can compete only with desk computer systems from the early 1980s, computer experts said.



ZZ500 Hand-Held Computer

Legend Group Builds 20-Million-Yuan Export-Oriented Plant in Shenzhen

92P60271A Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 15, 15 Apr 92 p 1

[Article by Liu Jiuru [0491 0046 1172]: "New Studies Forward in Legend Group's Industrialization"]

[Summary] On 5 April, the Legend Computer Group held a ribbon-cutting ceremony in Shenzhen to formally mark the completion and operational status of its 20-million-yuan export production facility—the nation's currently largest microcomputer board/card export plant—in Shenzhen's Shangbu district. CAS President Zhou Guangzhao and MMEI Vice Minister Hu Qili were among the dignitaries in attendance. The Legend Group has experienced rapid growth since its founding in 1989, with 1991 gross foreign sales of 320,000 microcomputer boards, representing US$37 million in foreign exchange earned. The new 3,600-square-meter facility will use advanced international production equipment to manufacture 300,000 boards and cards annually. A Legend Group official revealed that, with the new facility, the firm's 1992 microcomputer board/card output should reach 1.2 million units, or US$54 million in foreign exchange earned; this represents a 2 percent and 8 percent share of the world market for boards and cards, respectively. Also, the firm's 1992 gross domestic and foreign business volume could reach US$300 million.

Nation's Largest Software Export Base Taking Shape in Shenzhen

92P60271D Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 16, 22 Apr 92 p 1

[Article by Liu Jiuru [0491 0046 1172]: "Shenzhen Software Export Base Firmly Grasps New Construction"]

[Summary] The nation's largest software export base—centered on a Shenzhen Software Park now being built—is taking shape on a grand scale. According to the State's Eighth 5-Year Plan, Beijing, Shanghai, and Shenzhen will become the nation's three largest software bases, with Beijing and Shanghai specializing in systems software and applications software, respectively, while Shenzhen will concentrate on producing export software. The goal is for Shenzhen to capture a 50 percent share of the entire nation's software export volume. Also, Shenzhen will have priority with respect to development funds allocated to the three software bases.

Per the "Software Export Base Overall Plan," administered by the Shenzhen municipal government, various software production plants and firms in the Shenzhen area will form a closely knit and highly coordinated group centered around a Shenzhen Software Park. The first step toward this was taken on 11 January 1992, when MMEI and the Shenzhen municipal government formally completed the Shenzhen Software Park Agreement. Local authorities are now doing the planning and talent coordination for the park, which will be built in the Shenzhen S&T Industrial Park. MMEI has allocated 150 million yuan in investment funds, while the Shenzhen government will contribute land and some of the start-up investment capital, arrange for bank loans, coordinate industry resource pooling, attract foreign capital, etc. Gross Eighth 5-Year Plan investment is targeted at 300 million yuan, all of which has been basically arranged. By the end of the Eighth 5-Year Plan, Shenzhen is to have 3,000 software engineers and an annual export volume of US$100 million.

Details on Shenzhen Firm's Software Exports Revealed

92P60286C Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 8 May 92 p 2

[Article by Liu Keli [0491 0344 7787]: "Xinxin's [2450 2946] Multimedia Software Enters World Market"]

[Summary] Xinxin Software Industries Ltd., a firm located in Shenzhen's Shekou District, has commercialized about 100 export products—earning US$2 million in foreign exchange so far—in the area of multimedia software, a new 90s phenomenon even now little seen or heard of worldwide except among specialists. In one of Xinxin's laboratories, an engineer showed this reporter on the computer screen an "[aircraft] pilot school examination system," which has been exported to Hong Kong. With traditional methods, the test takes one month to administer, whereas only 1 hour is required to complete the examination with this multimedia system, combining text (e.g., curriculum vitae completion), photography, keyboard contact, and sound into a [virtual reality-type] organic whole. In another laboratory, this writer saw on screen a computer-aided instruction system for a HK$4 billion Hong Kong Science Museum and Outer-Space Museum. Earlier this year, representatives from a Taiwan museum signed a US$1 million contract with Xinxin for this product. Domestically, Xinxin's multimedia software products are being used at Qinghua University, at the CAS Software Institute, and at the Taiji Computer Corp., among others.

Software Industry Forming in Shenyang

92P60271E Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 16, 22 Apr 92 p 2

[Article by Weng Hansong [5040 1383 2646]: "Shenyang City Vigorously Developing Software Industry"]

[Summary] It has been learned from the 1992 Annual Meeting of the Shenyang Software Industry Association that the local government is vigorously promoting software industry development, and has been doing so since

its 1989 formation of the Software Industry Development Promotional Commission. The commission has engaged in a variety of supportive activities, including coordination, guidance, arrangement of international exchanges and new-product expositions, and awarding of prizes. More significantly, the city government has promulgated a software industry overall development plan, which stipulates that by the end of the Eighth 5-Year Plan Shenyang will have 10 backbone software firms, 10 pilot software plants, 40 software fist products, and an annual software revenue of 100 million yuan. In the past 2 years, the commission has helped develop over 200 new software products, representing a revenue of over 35 million yuan and over US$800,000 in foreign exchange earned. In addition, six joint-venture and sole-proprietorship software firms have been established in the Shenyang area.

Software Base To Add Byte to Local Industry

40100052B Beijing CHINA DAILY (SHANGHAI FOCUS) in English 1 Jun 92 p 1

[Article by Chen Qide, CD staff reporter]

[Text] Shanghai has joined forces with the central government to establish a software base in the Pudong New Area in a bid to boost the local software industry.

The Shanghai Municipal Government and the country's Ministry of Machine Building and Electronics Industry have signed a co-operation agreement which will yield at least 150 million yuan ($27.8 million) in investment. They already have set up an office in the area.

The project report is waiting for approval from the central government.

Office director, Sun Yuanhong, revealed the Shanghai Pudong Software Park Development Corporation would be set up soon to push the project.

China has decided to make breakthroughs in the software industry during the Eighth 5-Year Plan (1991-95) and the base is part of this plan.

Shanghai is home to more than 10,000 software professionals, so is playing a leading role in launching the industry.

The city has made progress in contracting foreign software projects as well as sending computer programmers overseas. More than 20 software enterprises are doing good business, said sources from the Changjiang Computer Union Corporation.

"But this hasn't made a big contribution to forming the city's software industry," the sources said.

The establishment of the base would create an environment for software development.

Sun, also deputy general manager of the Changjiang Computer Union Corporation, said his office was searching for an ideal location for the project, which is designed to inhabit an area of 300,000 square metres.

According to Sun, the software base is to be part of the city's planning science park which will be set up in Pudong's Beicai area.

The planned 19 square kilometre science park aims to put the city's scientific and technological findings to industrial use.

The strategy is part of the blueprint for the Pudong New Area, on the east bank of the Huangpu River, said sources from the city's Science and Technology Commission.

"We will be a pioneering contribution to the birth of the science park," said Sun.

He said the software base would have about 30 software enterprises including foreign-funded firms.

The focus will be put on applied software and support software.

Currently, overseas investors from more than 10 countries and regions including the US, Japan and Hong Kong and domestic investors have come to the office for talks on joint ventures, Sun said.

Two New Robot Simulation Systems Developed by Qinghua University

92P60305B Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 19, 13 May 92 p 2

[Article by Che Yu [6508 7183]: "Qinghua University Develops Two Robot Simulation Systems"]

[Summary] The ROBSM2 two-level robot simulation system and the DROBSM1 dual-hand single-level robot simulation system, developed by engineers in the Artificial Intelligence & Control teaching and research group in the Computer Department at Qinghua University as an "863" Plan (Intelligent Robot Systems Simulation area) key project, passed expert technical appraisal on 21 April [in Beijing]. ROBSM2's instructions are written in the SVAL language, a modification of VAL11, and the system can directly execute programs written in C; the system is also capable of independent operations in simulated 3D space. DROBSM1, a dual-mechanical-arm simulation system for studying the mechanics, dynamics, and control of such robots, includes techniques for evaluating two sets of model parameters: one set is for simulation and the other is for controller calculations.

Robot Manipulator for 300-Meter Diving Developed

92P60305A Beijing GUANGMING RIBAO in Chinese 4 May 92 p 1

[Photoreport by Lu Yonghua [4151 3057 5478] to accompany photo by Deng Ning]

[Summary] The "QSE-II single-person ordinary-pressure diving apparatus" robot, the nation's first manned robot for construction operations at depths of up to 300 meters, was recently formally turned over to the Navy for use at its Sanya [i.e., Ya Xian] [Naval Base] in Hainan Province. Commissioned by the Navy, this manned underwater robot was designed by the China Shipbuilding Scientific Research Center and manufactured by the Wuhan Machinery Plant.

Shown is the manned diving robot, whose external appearance closely resembles that of an astronaut's space suit.

RCS Analysis of Arbitrary Convex Conducting Targets via Facets Approximation Method

92P60301A Harbin HARBIN GONGYE DAXUE XUEBAO [JOURNAL OF HARBIN INSTITUTE OF TECHNOLOGY] in Chinese Vol 24 No 2, Apr 92 pp 57-63

[Article by Guo Wenyan [6753 2429 1750], Liu Jian [0491 0256], and Cheng Hongli [4453 1347 7787] of the Department of Radio Engineering: "Use of Facets Approximation Method for Analysis of Radar Cross Section of Arbitrarily Shaped Convex Conducting Targets"; MS received 25 Jun 91]

[Abstract] The basic principle of and specific implementation measures for using the facets approximation method (FAM) to analyze the radar cross section (RCS) of arbitrarily shaped convex conducting targets are presented. The monostatic and bistatic RCS of a sphere, spheroid, cone, cylinder, and frustum are calculated and compared with exact solutions and experimental values (taken from AD856560). The results demonstrate that the FAM, based on Physical Optics, is reliable and effective; the calculated values have an average error of 3-5 dB or less, and some calculated values (see Figure 6) are more accurate than values determined by the Geometric Theory of Diffraction (GTD). The author is currently applying and perfecting the method to analyze the RCS of complex targets such as missiles, and some good reference data has been obtained.

Figures 1-4 (not reproduced) show a generalized drawing of a scatterer and position vector, an illustration of the FAM applied to a prolate spheroid, a simple triangular facet, and the three vertices on a triangular facet. Figures 5-10, depicting specific results, are reproduced below.

References

1. Liu Jian, Guo Wenyan, "Using an Expanded Method of Physical Optics To Calculate the Radar Cross Section of Axially Symmetric Targets," HARBIN GONGYE DAXUE XUEBAO [JOURNAL OF HARBIN INSTITUTE OF TECHNOLOGY], 1991, 23(1).

2. Youssef, N., "Radar Cross Section of Complex Targets," PROC. OF THE IEEE, 1989, 77(5).

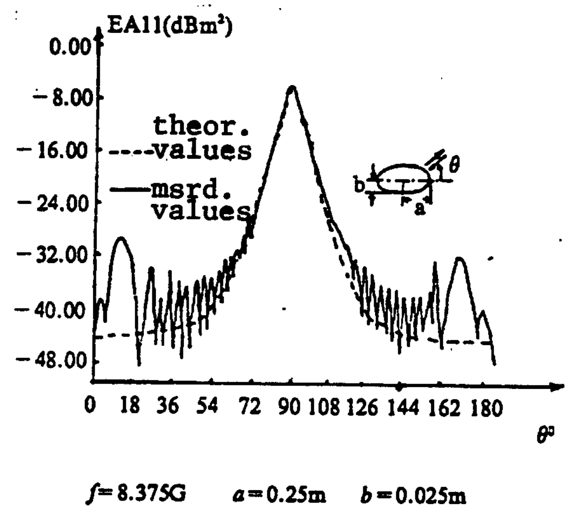


Figure 5. Monostatic RCS for a Prolate Spheroid

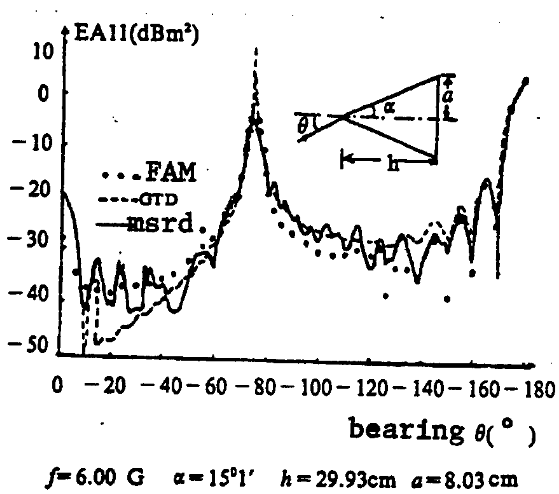


Figure 6. Monostatic RCS for a Cone

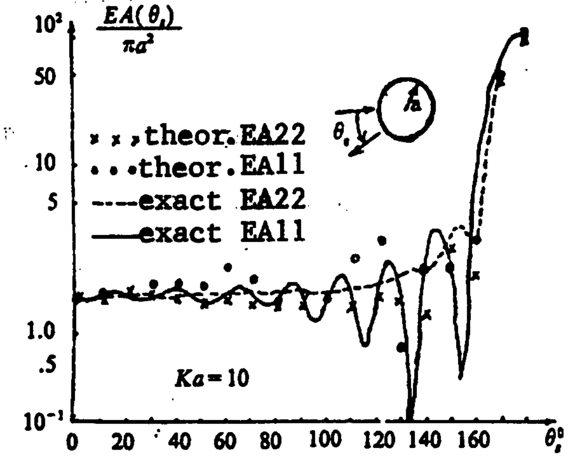


Figure 7. Bistatic RCS for a Sphere

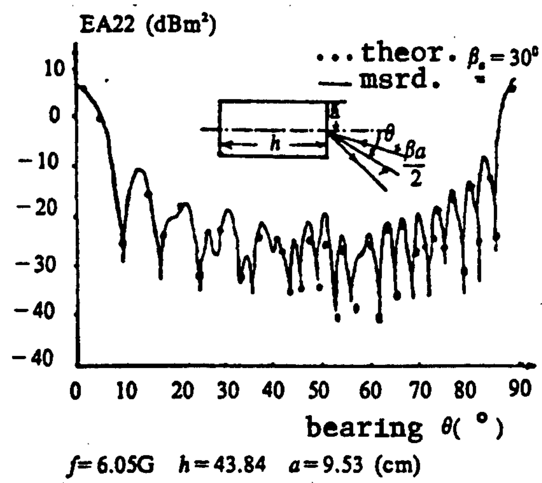


Figure 8. Bistatic RCS for a Cylinder

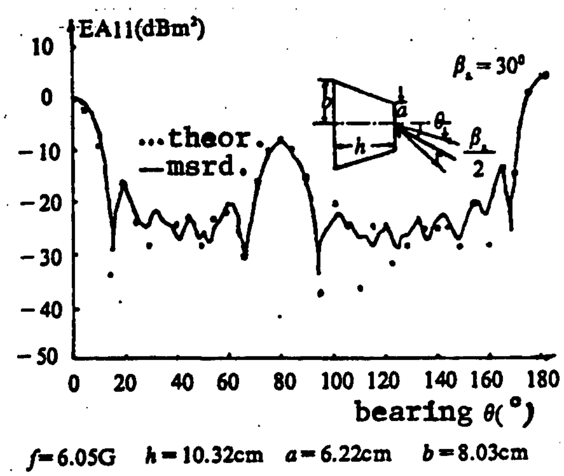


Figure 9. Bistatic RCS for a Frustum

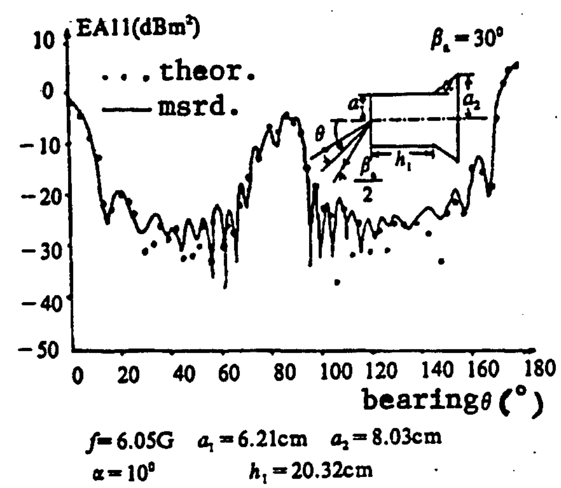


Figure 10. Bistatic RCS for a Cylinder-Frustum

An Iterative Method for Correcting the Located Coordinates of an Underwater Target

92FE0456B Beijing SHENGXUE XUEBAO [ACTA ACUSTICA SINICA] in Chinese Vol 17 No 2, Mar 92 pp 104-110

[Article by Wu Deming [0702 1795 2490] of the Department of Radioelectronics, Beijing University: "An Iteration Method for Correcting the Located Coordinates of an Underwater Target"; MS received 18 Mar 91]

[Abstract] There are numerous acoustic methods that deal with underwater target location. However, most of these methods assume that water is a homogenous medium and sound propagates in water along a straight line. In reality, it is nonuniform and sound propagates along a curve. When there is an underwater sound speed gradient, the distribution of sound velocity must be taken into account in determining the coordinates of the sound source. Unfortunately, precise solutions are often too complicated and

approximations are frequently inaccurate for most complicated hydrological conditions. This paper presents a fast and accurate iterative method for correcting the bending of the acoustic line to obtain the correct located coordinates of the target.

The method assumes that the underwater sound speed gradient distribution is laminar. This assumption is closer to reality when the number of layers is sufficiently large. Furthermore, the speed of computation is not affected by the large number of layers in this algorithm. A detailed description of the method is described. Derivation of the step-by-step iterative approach is also discussed. Finally, the effect of acoustic line correction is demonstrated with experimental data. Although the sound gradient was not large when the experiments were performed, the effectiveness of this correction is quite apparent.

References: 3 Chinese, 1 English.

Extracting Poles From Echo of Sonar Target

92FE0456A Beijing SHENGXUE XUEBAO [ACTA ACUSTICA SINICA] in Chinese Vol 17 No 2, Mar 92 pp 93-103

[Article by Liu Bosheng [0491 0130 0524] of Harbin Shipbuilding Engineering Institute: "Extracting Poles From Echo of Sonar Target"; MS received 3 Mar 90]

[Abstract] The echo of a sonar target carries certain characteristics of the target. In recent years, pole extraction has been used in auto-identification of sonar targets. In this work, based on singularity expansion theory, poles are extracted from a simulated echo signal by using Prony's method in order to investigate the impact of parameters such as sampling frequency dt, signal to noise ratio (SNR), pre-set number of poles N, number of samples M and residue in computation on the correctness of pole extraction. It was determined that in order to accurately extract all poles, sampling frequency should be five times higher than the highest frequency component of the echo. When the SNR is 20 dB, the relative error of pole extraction is less than 1.5 percent. However, at 10 dB, the error might be greater than 1.5 percent. N must be more than three times the number of real poles, but M does not seem to have any significant influence on the outcome.

In addition, an attempt was made to eliminate false poles by assuming that false poles would not reappear. Finally, poles were extracted from a measured echo from a sphere. It was found that the results were consistent with theoretical values. This demonstrates that certain characteristic information of the target can be obtained by extracting poles from its sonar echo.

References: 2 English, 2 Chinese.

GaAs/AlGaAs Multi-Quantum-Well IR Detector Certified

92P60272A Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 13 Apr 92 p 3

[Article by He Chunfan [0149 2504 5672]: "Domestically Developed Quantum-Well Infrared Detector Unveiled"]

[Summary] The GaAs/AlGaAs multi-quantum-well IR detector jointly developed by the CAS State Laboratory for Surface Physics and the Ministry of Aerospace Industry's Shanghai Institute 803 recently passed technical appraisal. This dual-use high-performance IR detector's peak wavelength, peak voltage responsivity, peak detectivity and other performance indicators all match those of the international state-of-the-art, according to test data obtained by the appraisal specialists. This cutting-edge achievement represents a major breakthrough for the nation's development of multi-quantum-well long-wavelength IR focal plane arrays and provides a firm foundation for applications in aerospace guidance systems.

Remote Controlled Laser Cloud-Detection Radar Developed by Air Force

92P60306A Beijing GUANGMING RIBAO in Chinese 6 May 92 p 2

[Article by Zhao Dexin [6392 1795 2450] and Lei Yusheng [7191 2810 3932]: "Air Force Develops Remote Controlled Laser Cloud-Detection Radar"]

[Summary] In a 6-year effort, engineers at the Seventh Research Institute of the Air Force have developed a remote controlled laser cloud-detection radar for use at military and civilian airports. This world state-of-the-art radar, recently formally certified and now in production, has a remote control range of 10 km, can detect cloud bottoms in a range from 65 m to 5,460 m, and displays the solution within 30 seconds.

Transmission/reception, detection, search/store, and display are all fully automatic.

Optical Fiber Faceplate Developed by Taiyuan Radio Plant

92P60306C Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 15 May 92 p 6

[Unattributed article: "Optical Fiber Faceplate Developed by Taiyuan Radio Plant No. 4"]

[Summary] In an 8-year effort, engineers at Taiyuan Radio Plant No. 4 have developed optical fiber faceplate, a critical material used in image intensifiers and low-light-level night vision devices, and one that therefore has great military and civilian economic value. In the military, these devices are used for ground, air, and sea reconnaissance. Civilian applications include TV tracking, resources exploration, medical diagnosis, and

security monitoring. In the past, China was forced to import this technology. The domestic fiber faceplate has been formally certified by a panel of experts, who have appraised its detection performance as meeting that of comparable international products.

Intelligent Weather-Satellite Ground Receiver Unveiled

92P60306B Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 19, 13 May 92 p 19

[Article by Yang Bin [2799 1755]: "Intelligent Weather-Satellite Ground Receiver Unveiled in Nanjing"]

[Summary] The Zhong Shan Group's Nanjing Daqiao [1129 2890] Machine Plant has developed the model WT-7 weather-satellite ground receiver. This microcomputer-controlled receiver has two image processing systems: one system for polar-orbit-satellite remote sensing data, with a 5-channel (including visible, near IR, and far IR) display, three channels of which permit color graphics synthesis, and one system for geosynchronous satellite imagery. This high-tech equipment is the first domestically developed unit which can receive imagery from the five satellites forming the global-coverage atmospheric tracking and control network, and has been used experimentally to receive coded meteorological data transmitted from the 800-km-altitude U.S. NOAA-11 weather satellite. The system's "intelligentized" functions are exemplified by its ability to predict agricultural crop harvests in areas affected by natural disasters.

Nd:Glass Pulsed Laser Heat Treatment Machine Certified

92P60272B Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 17 Apr 92 p 2

[Article by Peng Dejian [1756 1795 1696]: "China University of Science & Technology Develops Neodymium:Glass Pulsed Heat Treatment Machine"]

[Summary] Following upon their development of the world's first 10-gigawatt tunable Nd:glass laser [see JPRS-CST-90-027, 29 Oct 90 p 15], researchers at China University of Science & Technology's High-Power Laser Laboratory turned their attention to industrial products—these researchers have now perfected a Nd:glass pulsed laser heat treatment machine, which passed technical appraisal the other day. The new method, which has advantages over the traditional CW CO_2 heat treatment machine, was developed in a project beginning in March 1985 and undertaken at the request of engineers in the Hefei Meters Plant for processing of the 4-chromium-13 stainless steel used in various axles.

Nation's First Laser Gate-Array Laboratory Operational

92P60287A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 7 May 92 p 1

[Article by Wang Hanlin [3769 5060 2651 and Qiu Yide [6726 3015 1795: "First Laser Gate-Array Laboratory Operational"]

[Summary] The nation's first laser gate-array laboratory was formally put into operation on 4 May at the Ministry of Aerospace Industry's Microelectronics Center, indicating a major step forward for domestic development and production of digital ASICs. The laboratory's "laser gate-array circuit development system" is applicable to two new technologies: silicon compiled technology and laser direct-write technology. The designer need only input the new ASIC's logic diagram, high-level language or network layout into the workstation, and a full set of design processes are automatically implemented. Independently operated by laboratory personnel, the system has demonstrated a product yield of 25 percent, approaching the world standard.

Development of Bloch-Line Memory Devices Highlighted

92P60307A Chengdu SICHUAN RIBAO in Chinese 10 May 92 p 3

[Article by He Zhengyi [6320 2973 5030]: "The Charm of 1 cm^2"]

[Summary] At the nation's only magnetics research institute—the China Southwest Institute of Applied Magnetics—scientists gave this writer a vivid description of the realm of 1-cm^2 microstructure non-volatile computer memory devices. The most interesting and advanced form of device is the Bloch-line memory device: on such a 1 cm x 1 cm chip, one can store 1 gigabit of data, or 33.55 million characters, as opposed to only 0.05 megabit for the same surface area on a floppy disk. This type of bubble-memory device [Note: the characterization of Bloch-line devices as a type of bubble-memory device is not uncommon, but technically inaccurate, since Bloch-line devices store data by the particular rotation of the magnetization in the Bloch walls separating the ferromagnetic domains, rather than by the presence or absence of magnetization, as in bubble-memory devices—JPRS], named after the American scientist who first formulated the relevant ferromagnetic theory in the 1930's, has been hotly pursued by a number of advanced nations in recent years for its applications as a high-density, non-volatile memory device ideal for use in mainframe computer systems, atomic bombs, satellites, and high-frequency communications systems.

Scientists at the Southwest Institute of Applied Magnetics—especially Zhang Sijun [4545 1835 0193], Zhou Yongfu [0719 3057 1381], and Guo Xingyu [6753 5281 0151]—have been studying this interesting technology since 1985, including reviewing over 8 million words of written English and Japanese data and participating in international exchanges. A problem, however, has been financial support from our government. The French over a 4-year period have invested US$5 million in R&D of Bloch-line memory devices, whereas our government, with limited funds, has appropriated only 500,000 RMB for Bloch-line memory device development over a 5-year period.

The past 7 years of tireless effort and knowledge is concentrated in this 1-cm^2 chip the scientists are examining in a microscope. One of the scientists told this reporter that over this 7-year period, his research group had completed 239 items [i.e., project achievements], of which two are at the international state-of-the-art, and 61 of which match or approach the leading values worldwide. Japan and France announced trial-manufacture of Bloch-line memory chips in 1991. Compared to these two nations, China is somewhat behind, but the institute researchers have made gratifying progress in domain stabilization/adjustment and in materials research for Bloch-line devices and overall have reached the mid-to-late-eighties stage compared to Japan and France.

Long-Wavelength InGaAs/InP APD Optical Receiver Module

40100055A Shanghai HONGWAI YU HAOMIBO XUEBAO [JOURNAL OF INFRARED AND MILLIMETER WAVES] in Chinese Vol 11 No 1, Feb 92 pp 21-26

[English abstract of article by Hu Chunyang, Wan Shutang, Zeng Jing, Xia Caihong, He Jun, and Zhou Zhou of the Institute of Semiconductors, Chinese Academy of Sciences, Beijing 100083, China; MS received 11 Feb 91, revised 22 Jun 91]

[Text] Based on theoretical analysis and computation, a new type of high-sensitivity optical receiver module for 140 Mb/s long-wavelength optical fiber communication is developed. The optical receiver consists of an InGaAs/InP SAGM avalanche photodiode (APD) and a silicon bipolar junction transistor (BJT) transimpedance preamplifier. It is hybrid-integrated. The calculated sensitivity at 1.3 μm is -48.6 dBm and the measured one is -47 dBm, values superior to those obtained with available PIN/FET, or Ge APD.

Photoluminescence Studies of Defects in GaAs

40100055B Shanghai HONGWAI YU HAOMIBO XUEBAO [JOURNAL OF INFRARED AND MILLIMETER WAVES] in Chinese No 11 No 1, Feb 92 pp 27-36

[English abstract of article by Weng Yumin, Liu Song, and Zong Xiangfu of the Institute of Materials Science, Fudan University, Shanghai 200433, China; MS

received 2 Jul 91, revised 26 Sep 91. The project partially supported by the Electronic Science Foundation of China.]

[Text] Deep-level defects in undoped semi-insulating GaAs are investigated by photoluminescence (PL) technique. Several PL emissions related to deep-level defects and their behaviors have been observed. The emission band at 0.69 eV is due to the well-known main mid-gap level EL2 and the 0.77 eV PL bands attributable to the transition from the conduction band to the As_{Ga} donor level. It is suggested that the 1.447 eV and 1.32 eV PL emissions are caused by the double acceptors Ga_{As}, with levels 78 meV and 203 meV above the valence band, respectively.

X-Ray Double-Crystal Diffraction of Superlattices and Its Computer Simulation

40100055C Shanghai HONGWAI YU HAOMIBO XUEBAO [JOURNAL OF INFRARED AND MILLIMETER WAVES] in Chinese Vol 11 No 1, Feb 92 pp 37-42

[English abstract of article by Ma Lin (present address: Computer Company of Qinghua Univesity, Beijing 100084, China), Wang Yutian, and Zhuang Weihua of the National Laboratory of Semiconductor Superlattice Microstructure, Institute of Semiconductors, Chinese Academy of Sciences, Beijing 100083, China; MS received 28 Apr 90, revised 3 Sep 90. The project supported by the National Natural Science Foundation of China.]

[Text] By using the X-ray diffraction kinematical theory which assumes ideally sharp interfaces, with computer simulation calculation, the accurate values of $(GaAlAs)_m(GaAs)_n/GaAs(001)$ one-dimensional superlattice structure parameters have been obtained. In addition, the influence of asymmetry of the satellite peak intensity and the presence of the transition layer and the strain have also been analyzed and discussed.

GaAs/AlGaAs Multiple-Quantum-Well 7 μm Infrared Detector

40100055D Shanghai HONGWAI YU HAOMIBO XUEBAO [JOURNAL OF INFRARED AND MILLIMETER WAVES] in Chinese Vol 11 No 1, Feb 92 pp 43-46

[English abstract of article by Fang Xiaoming, Huang Xinliang, Liu Wei, Li Yanjin, and Shen Xuechu of the National Laboratory for Infrared Physics, Shanghai Institute of Technical Physics, Chinese Academy of Sciences, Shanghai 200083, China; Zhou Xiaochuan, Zhong Zhantian, Jiang Jian, Xu Guichang, Du Quangang, Mo Shanming, and Li Chengfang of the National Laboratory for Surface Science, Chinese Academy of Sciences, Beijing 100080, China; Zhou Dingxin, Yu Meiyun, and Yu Xiaozhong of Shanghai 803 Research Institute of the Ministry of Aerospace Industry, Shanghai 200233, China; MS received 21 Oct 91, revised 6 Nov 91]

[Text] The detection of blackbody radiation by GaAs (51 Angstrom)/$Al_{0.36}Ga_{0.64}As$ (200 Angstrom) multiple-quantum-well infrared detector having a peak wavelength of 7 μm with D* [detectivity] = 1.09×10^9 cm-$Hz^{1/2}$-W^{-1} and R_v [responsivity] = 2.5×10^4 V-W^{-1} at 77K is reported.

HTS Bismuth-Based Tape Developed by Beijing Institute

92P60308A Beijing GUANGMING RIBAO in Chinese 4 May 92 p 2

[Article by Zhou Fangyan [0719 5364 3601]: "A Younger Person in the 'Superconductivity Chase': Interview With Engineer Ye Bin From Beijing General Institute of Nonferrous Metals"; cf. JPRS-CST-92-007, 16 Apr 92 p 33]

[Summary] Young Engineer Ye Bin [0673 2430] from the Beijing General Institute of Nonferrous Metals described to this reporter his pursuit of the "hot topic" of high-temperature superconductivity (HTS) since his completion of graduate school in 1990. In this short period of 2 years, Mr. Ye, 24, and his research group have been responsible for several outstanding, world-class achievements. In HTS projects assigned by the State Superconductivity Center, Ye's group at the Beijing institute was asked to develop a 1-tesla-field (1-T field) bismuth-based (Bi-based) tape with a critical current density (J_c) of 1,000 A/cm^2, but their actual achievement was a Bi-based tape with a J_c of 4,100 A/cm^2 for a 1-T field, and 28,700 A/cm^2 for a zero-T field; the group also has developed a flexible Bi-based superconducting tape with a J_c of 10,000 A/cm^2 that essentially remains unchanged for a bending radius of over 20 mm. These two achievements are major steps forward in the domestic development of practical HTS materials, and are at the world state-of-the-art. More recently, the group, led by Senior Engineer Zhou Yiru [0719 6318 5423], has developed a 2-meter-long superconducting tape with a J_c of 5,000 A/cm^2.

Nation's HTS Research Remains at World's Forefront

92P60308B Beijing RENMIN RIBAO [PEOPLE'S DAILY] (Overseas edition) in Chinese 26 May 92 p 1

[Article by Yang Lianghua [2799 5328 0553]: "Nation's High-Temperature Superconductivity Research Still in World's Front Ranks"]

[Summary] Beijing, 25 May—It has been learned from the Beijing International High-Temperature Superconductivity Conference convened today that the nation's several hundred HTS researchers have recently been responsible for new achievements that maintain China's status among the world's front ranks in HTS R&D—achievements that have aroused the attention of HTS researchers abroad. China's researchers have published over 2,000 papers in the HTS field in the past few years, and have contributed several ideas to the international scholarly study of the electrical characteristics of high-temperature superconductors. In addition to studying the usual copper oxides, non-copper-oxide compounds, and cluster compounds, the nation's researchers have recently synthesized tantalum-based (Ta-based) and niobium-based (Nb-based) high-temperature oxide superconductors, and have developed a thallium-barium-calcium-copper oxide (Tl-Ba-Ca-Cu-O) superconductor with a transition temperature of 127.5K. Using the melt-textured growth (MTG) technique, China's researchers have developed a YBCO bulk superconductor with a 70,000-Gauss-field critical current density of 100,000 A/cm^2 at a temperature of 77K—a new world's record. In addition, the nation's HTS scientists have developed Bi-based Ag-covered superconducting tape with a critical current density taking first place in the world [see preceding article], and have applied superconducting quantum interference devices [SQUIDs] in the field in areas such as geoelectromagnetics and oil-field exploration.

New Bundle-Tube Fiber Optic Cable, 300,000-Pixel Silica Fiber Technology Certified

92P60273B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 4 May 92 p 1

[Article by Li Mingqi [2621 2494 0796] and Wang Peilai [3769 1014 0171]: "New Achievements in Nation's Research on Fiber Optic Technology"]

[Summary] China has just had new breakthroughs in research on fiber optic technology: the development of a superstrong bundle-tube fiber optic cable and 300,000-pixel silica optical fiber image-transmission technology by a Northern Jiaotong University research team led by Prof. Jian Shuisheng [4675 3055 3932]. These two achievements recently passed the technical appraisal organized by the Beijing Municipal S&T Commission at the request of the State Planning Commission. The superstrong bundle-tube fiber optic cable, a now-patented device whose development was a key Eighth 5-Year Plan project, has a tensile strength and compressive strength both exceeding 5,000 newtons, a value higher than that of the comparable internationally available product. The 300,000-pixel silica fiber image-transmission technology has many applications in areas such as industry, national defense, and medicine, and was heretofore manufactured only by Japan. China's manufacturing technique employs domestically existing production equipment throughout.

Nation's First 1.55-Micron Unrepeatered Fiber Optic Cable Communications System Passes Acceptance Check

92P60309A Beijing RENMIN RIBAO in Chinese 13 May 92 p 1

[Article by Lu Xinning [4151 2450 1337]: "New Breakthrough in Nation's Fiber Optic Communications Technology: Nanjing-Wuhu Fiber Optic Cable Communications Project Passes Acceptance Check"]

[Summary] Beijing, 12 May—The nation's first 1.55-µm unrepeatered fiber optic cable communications system—the 110-km-long Nanjing-Wuhu fiber optic cable communications project—passed state acceptance check a few days ago. The system's technical quality meets international advanced standards, indicating yet another breakthrough in domestic optical communications technology. The Nanjing-Wuhu line uses the new-generation bundle-tube fiber optic cable jointly developed by Northern Jiaotong University Prof. Jian Shuisheng [4675 3055 3932] and the Beijing (Electric) Wire Plant. The Shanghai Railway Office's Survey and Design Institute and the Beijing Optical Communications Co. acted as overall contractors. With the new 1.55-µm-wavelength technology, one fiber optic cable can carry up to 480 simultaneous digital voice circuits at the DS3 [i.e., 34 Mbps] transmission rate. If optical frequency-division multiplexing [OFDM] technology is added, the system can carry over a hundred million digital telephone [circuits].

Sino-Japanese Joint Venture Tianjin-NEC Ltd. Established

92P60273A Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 17, 29 Apr 92 p 1

[Article by Zhang Xiongwei [1728 7160 0251]: "Another Major Sino-Japanese Joint Venture: Tianjin-NEC Electronic Communications Industries Ltd. Formed"]

[Summary] Tianjin NEC Electronic Communications Industries Ltd., Tianjin Municipality's largest Sino-foreign joint venture so far, was formally established on 14 April. Tianjin-NEC is a four-party joint venture, consisting of Tianjin's Zhonghuan Computer Co., Tianjin Municipality's P&T Management Office, NEC, and Sumitomo Corp. With a gross investment of US$64 million and registered capital of US$32 million, Tianjin-NEC will primarily engage in the manufacture, sales, installation, maintenance, and development of NEC's NEAX61 stored-program-controlled (SPC) digital telephone switching system, with an eventual (planned by 1993) production capacity of 300,000 lines. Planned production for the first 6 months of this year is 100,000 lines, 70,000 of which are to be sold. The joint venture, based in Tianjin's Computer Industrial District, has a 19,500-square-meter plant, basic construction on which is already completed; completion of all construction is scheduled for the end of this year.

Wuhan Group Forms Fiber-Optics Joint Venture With NEC

92P60315B Beijing DIANXIN JISHU [TELECOMMUNICATIONS TECHNOLOGY] in Chinese No 5, May 92 P 48

[Summary] On 10 February 1992, the Wuhan Municipal Changjiang Optical Communications Industries Group formally reached agreement with Japan's NEC and Sumitomo Corp. to establish Wuhan-NEC Optical Communications Industrial Ltd. This new joint venture will import NEC's optical communications systems production technology permitting annual output of 4000 optoelectronic terminals, monitoring systems, and testing equipment. A series of optical communications products are to be on the domestic and foreign markets by the third quarter of this year, and will be compatible with products made by Changfei Optical Fiber & Cable Ltd. (a Sino-Dutch joint venture also based in Wuhan) and by another Sino-Japanese joint venture, Tianjin-NEC Ltd. [see previous article].

Tianjin Imports Fiber-Optic-Cable Production Line from Nokia

92P60288B Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 8 May 92 p 1

[Article by Li Zanmin [2621 6363 3046]: "Tianjin Imports Fiber-Optic-Cable Production Line"]

[Summary] On 28 April, a worldwide-state-of-the-art fiber-optic-cable production line imported by the Tianjin Municipal Electronic Wire & Cable Co. was formally put into operation. Tianjin is one of the three largest optical communications bases determined by the state government, and the Tianjin cable firm's new production line, imported from Finland's Nokia Corp., represents a major step toward implementation of the state's development plan. The new line has an annual production capacity of 2,000 kilometers of fiber optic cable, and has been in trial operation for 1 year, with all performance indicators meeting design targets.

Another Fiber Optic Cable for Fujian Province Completed

92P60315C Beijing DIANXIN JISHU [TELECOMMUNICATIONS TECHNOLOGY] in Chinese No 5, May 92 p 48

[Text] An almost 2-year-long project to build a 290-km-long level-2 fiber optic cable in Fujian Province's Longyan Prefecture was completed the other day. Longyan's seven counties have now all realized long-distance digital transmission, and communications capacity has grown over 1000 percent.

Shanghai Building Indian Ocean Satcom Ground Station

92P60315A Beijing DIANXIN JISHU [TELECOMMUNICATIONS TECHNOLOGY] in Chinese No 5, May 92 p 48

[Untitled news brief by Yi [6318]]

[Text] In order to improve communications between Shanghai and the European mainland, Shanghai is building an Indian Ocean communications satellite ground station, which will serve as a sister station to the existing Shanghai Pacific Ocean satcom ground station. Gross investment for the entire project is 30 million yuan, and the main communications equipment is being imported from the U.S. The project, to be completed within the first half of this year, will open up 600 voice circuits and permit simultaneous receiving and sending of two satellite TV programs.

Domestically Developed Large-Screen Digital Color TV Unveiled

92P60288A Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 4 May 92 p 3

[Article by Fang Shifen [2075 0013 5358]: "China Develops Large-Screen Digital Television"]

[Summary] An independently designed large-screen digital color TV has been developed by MMEI's Institute 3. On 24 April, a panel of experts conducted a technical appraisal of five prototypes of the model-I digital color TV and appraised their technical performance as matching the international state-of-the-art. Digital TV not only represents a new technology, but a particularly relevant new technology, since it is compatible with HDTV. The former Zhongdian ["China Electronics"] Group, now the CHINATRON Corp., began studying digital TV in 1985 at the request of MMEI. The unit has concentrated its research into a two-phase program: phase I consisted of development of the model-I digital TV, which is a multifunctional, multi-format video-band model with picture-in-a-picture functions, while phase II consists of development of the model II digital TV, which will have improved image quality and high frequency-band picture-in-a-picture functions. In 1989, 41 units formed the "China HDTV and Digital TV Club," organized development of digital TV and coordinated research into applications of digital technology for improving analog color TV products. The successful development of the model-I digital color TV by MMEI's Institute 3 indicates that the nation's TV product technology has entered a new era.

The model-I digital TV has a 71-cm planar right-angle picture tube, is multifunctional and multi-format-capable (including PAL, SECAM, and NTSC) for both main picture and for the smaller picture-in-a-picture boxes. From one to three picture-in-a-picture boxes can be formed on the screen at any one time, and the position and size of the boxes can be varied. The model comes with a remote control and digital program pre-selection control. The tuner incorporates digital frequency synthesis technology. Brightness and color are controlled by digital filters. Also, the model-I digital TV has stereo sound.

Russian-Designed Tokamak Device To Aid China's Fusion Research

40100051A Beijing CHINA DAILY in English
3 Jun 92 p 5

[Article by Zhou Jie: "Tokamak Device To Aid China's Fusion Research"; first two paragraphs are CHINA DAILY introduction]

[Text] Anhui is one of China's less developed areas. Yet, it has some of the country's highest technology in laser science, high energy physics and fusion research.

Our staff reporter Zhou Jie recently visited this inland province. What follows is the first of his series of reports on Anhui's high-tech development.

Chinese and Russian scientists are working together to install the world's third-largest superconductor Tokamak reactor, a critical device for fusion research, in Hefei, capital of East China's Anhui Province.

The Tokamak device was originally developed in the former Soviet Union in 1983. Known as T-7, it was the first superconductor Tokamak in the world. In 1988, a larger Tokamak device called T-15 started operation in the former Soviet Union, putting the T-7 into early retirement.

Last year, according to a cooperation agreement reached a year before, Russia presented the Tokamak, valued at $16 million, to the Anhui-based Institute of Plasma Physics (IPS) under the Chinese Academy of Sciences.

In return, China sent computers, leather clothing and down coats that were worth 250,000 yuan ($45,454) to Russia.

The installation of the Tokamak device is scheduled to be finished by February 1993.

Technicians in the institute are working day and night to reassemble this equipment in a large workshop on a peninsula on the outskirts of Hefei, where the institute is located.

The work is more than merely a refitting and refurbishment. Technicians are restructuring the Russian Tokamak, opening more windows on the device for study, according to Wang Kongjia, an associate professor who is assistant director of the IPS.

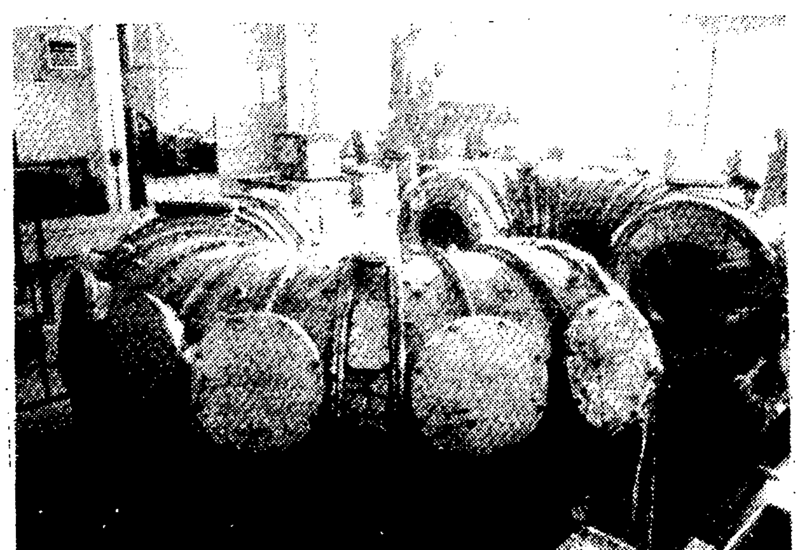
Several groups of Russian scientists from the IV Kurchatov Institute of Atomic Energy, developer of the T-7, have come to Hefei to help with the installation.

Scientists in the institute believe that the new Tokamak will speed up China's research in fusion science.

"The Russian Tokamak remains excellent in the world. We still can not produce many of its features," said assistant director Wang.

It has long been a dream of energy scientists around the globe to use the fusion reaction process to create a clean and virtually inexhaustible energy supply.

Fusion reaction, the process that gives the sun and other stars their energy, uses hydrogen's two other forms, deuterium and tritium, as its energy sources. Deuterium and tritium can be produced out of sea water. In fusion,



T-7, the third-largest superconductor Tokamak in the world, was transported from Russia to China and was adapted and installed in Hefei.

the deuterium and tritium in one litre of sea water can generate as much energy as that from 300 litres of petroleum in combustion.

A hydrogen or thermonuclear bomb is an example of nuclear fusion with military potential.

If nuclear fusion can be controlled and put into commercial use, the energy resource could be nearly limitless and the extraction process relatively clean and safe, compared with nuclear fission.

In November 1991, an experiment at Joint European Torus (JET) in Culham, England, achieved fusion for two seconds and produced about 1.7 megawatts of power for nearly a second. That, to date, is the most successful experiment in controlled fusion reaction.

Scientists believe a commercial fusion reactor remains at least 50 years away. Even at JET, the ratio between the input energy and the output energy is 100:0.1, which means that the reactor consumes much more energy than it generates.

China started fusion research for peaceful purposes in the 1970s, following the successful explosion of its first hydrogen bomb in the western desert in 1973.

The IPS was founded in 1978, and is one of two units in the country doing fusion research. The other is in Southwest China's Sichuan Province.

Researchers with the institute have been taking part in several international research projects in fusion science, including JET.

"Our ultimate purpose is to develop a commercial fusion-fission joint reactor in the next 30 to 40 years," said Wang.

"To develop a commercial fusion reactor to generate electricity requires enormous investment, which is impossible in China. There is a cheaper and easier way: use a fusion rector as a strong neutron source to turn the Uranium-238, which widely exists in nature, into the nuclear fission fuels Polonium-239 or Uranium-233. That will enable us to obtain large, if not limitless, quantities of fuel for nuclear power stations," said the fusion expert.

Previously, the IPS has developed two Tokamak devices. One is still working.

Major Success Claimed for HL-1

92FE0533B Chengdu SICHUAN RIBAO in Chinese 14 Apr 92 p 2

[Article by Li Qiming [2621 07969 2494] and Qing Yuanshu [7230 6678 2873]: "Major Progress Made With HL-1"]

[Text] The Southwest Institute of Physics of the Ministry of Nuclear Industry successfully has completed 399 research and development projects as it implements the technical system reform policy which stresses cooperation and exchange worldwide. It received 95 major technical achievement awards handed out by the province and brought controlled nuclear fusion research to an advanced level.

The HL-1, constructed in September 1984, is the largest research controlled-nuclear-fusion apparatus in China. In order to strengthen worldwide technical cooperation and exchange, the institute has sent over 120 technical people to visit and work in countries such as the U.S., U.K., Germany, Italy and Japan. It has invited over 660 scholars and experts from more than 20 countries and territories to lecture and work in China as well. Furthermore, it has collaborated with other research institutes and higher-learning institutions in China on a number of projects to elevate the level of the technology. In 1991, the laboratory successfully made a conversion from a low confinement mode into a high confinement mode and substantially improved the status of ohmic confinement. These two major achievements are the results of applying advanced physical concepts in international cooperation and exchange to our own experimental apparatus. In addition to these achievements, more than 30 papers have been presented at various international conferences and over 30 young scientists have become technical leaders in major research subjects.

Accelerator Mass Spectrometer Detailed

92FE0533A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 3 May 92 p 2

[Article by Jiang Shan [1203 1472] and Chang Jiachen [1603 3946 6591]: "Progress in Accelerator Mass Spectrometer Applications"]

[Text] A mass spectrometer is an analytical tool that consists of three major components, i.e., an ion source, analyzer and collector. It is primarily used to measure the masses of different isotopes of various elements and their contents. It was invented in the 50's and China's first mass spectrometer was constructed in the early 60's. The principle of operation is to ionize the substance to be analyzed at the ion source. When the ions pass by the analyzer, because of their different masses, different isotopes follow different paths to reach different collectors. From the location and intensity of the signal of each collector, it is possible to determine the mass and content percentage of every individual isotope.

The accelerator mass spectrometer (AMS) is a new technology developed in the past decade. It is primarily used to analyze minute elements in a specimen. Compared to a conventional mass spectrometer, ions of the element to be analyzed are accelerated to MeV (million electron volt) level in an AMS by an accelerator before analysis. The AMS is highly sensitive, requires less sample and measures with high efficiency. The AMS is the best means to measure minute amounts of long-half-life naturally occurring isotopes produced by cosmic rays (e.g., C-14, Be-10, Cl-36, etc.). By way of analyzing

these isotopes, it is possible to unveil certain historical information such as the dates of certain geological events and changes in cosmic rays.

The first AMS was built at China Research Institute of Atomic Energy Sciences (RIAES) in 1989. In 1990, researchers successfully used the AMS to obtain the Be-10 depth profile of a deep-sea manganese nodule and determined that the manganese nodule grew at a rate of 1-5 mm per million years. This important piece of scientific data was provided to the relevant organization. The successful determination of Be-10 also demonstrated that the AMS had become an applied tool in China.

In 1991, researchers began the determination of C1-36 (half-life 300,000 years) and established a preliminary method to measure I-129 (half life 15 million years). The determination of C1-36 and I-129 has a great deal of significance in astrophysics, ecology and nuclear safety. For example the determination of C1-36 in underground water can reveal whether the water is stored in an ancient, sealed geological structure or in an open geological structure. An ancient and sealed geological structure is an ideal site for permanent storage of highly radioactive nuclear waste.

In cooperation with Beijing Institute of Geology of the Ministry of Nuclear Industry and China University of Geology (Wuhan), RIAES has completed a preliminary measure of C1-36 and I-129 in uranium ore and underground water at Lianshanguan in northeastern China. Furthermore, a study was conducted to measure C1-36 in surface and underground water at a place in Hebei. There was a surprise in the measurement of C1-36 in surface and underground (nearly 1,000 meters beneath the surface) water in Hebei. The measured C1-36 level in surface water agreed with the theoretical value and other data obtained in foreign countries. However, the C1-36 content in underground water is approximately one order of magnitude higher than that in surface water. This anomaly might be caused by two possible sources. It was either contaminated in the laboratory after sample collection or the underground water itself was contaminated by the geological environment. The potential source of contamination might be the uranium-containing layer or the 100,000-year-old meteorite buried nearby. Since contamination in the laboratory is highly unlikely, it was probably contaminated by its geological surrounding. Whether it is due to the uranium or the meteorite becomes a topic of considerable interest. Some experts pointed out that uranium-ore exploitation in China only goes as deep as 200-300 meters. Deeper uranium mines have not yet been discovered yet. Analysis of C1-36 in underground water might be a new technique for locating uranium.